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WAR MACHINE

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M107/110 in Action

Artillery in the British Army of the Rhine

Anatomy of a Soviet Self-Propelled Artillery Unit

Armed Forces of the World: RAF Support Command

A fully illustrated guide to Modern Self-Propelled Guns and Howitzers

WAR MACHINE

Volume 2 **Issue 15**

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U.S. AIR FORCE

Cover picture: A 175-mm (6.98-in) M107 self-propelled gun in service with the British Army.

Modern Self-Propelled Guns and Howitzers

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Used in Vietnam to provide long range fire support, the M107 has since been phased out of American service to be converted to 203-mm (8-in) M110A2 howitzer systems. Many other armies who use the equipment are likely to follow suit.

Since the end of World War II the self-propelled gun and howitzer has become an essential part of the modern battlefield scene. As one of the vital components of the combined arms concept, self-propelled artillery has a vast array of fire control aids and types of ammunition available in order to produce exactly the amount of fire to suit any situation.

Self-propelled guns and howitzers are by no means a new invention as in World War I the British developed a version of the tank that could transport a towed artillery piece across the battlefield. Between the world wars much work was done on self-propelled artillery weapons but hardly any of these were in service by the time that World War II broke out. During this conflict Germany and the United States devoted considerable resources to the development and production of self-propelled guns and howitzers and some of these, such as the M7 'Priest', remain in service today.

After the war Western armies became increasingly mechanized and, as towed guns could not be expected to keep up with these units, self-propelled guns and howitzers were developed and deployed on a large scale. These were mostly of the 203-mm (8-in) 155-mm (6.1-in) and 105-mm (4.13-in) calibres, although by the 1960s the last was being phased out in most countries due to preference for the more effective 155-mm (6.1-in) weapon which could also fire a nuclear projectile.

It is only in recent years that the Soviet Union has started to deploy self-propelled guns and howitzers on a large scale, although specialized tank destroyers and assault guns have been in service for many years.

The recent conflicts in the Middle East have again proved that there is no substitute for self-propelled artillery, which is now an essential part of the combined arms concept with armour, infantry, engineers and helicopters. For a variety of reasons towed rather than self-propelled artillery was used in the Falklands campaign of 1982 but there is little doubt that this was one of the deciding factors in the rapid collapse of Argentinian morale.

Sweden was the first country to deploy a self-propelled gun with an automatic loading system: the Bandkanon 1A, but this was never exported. France has recently deployed the 155-mm (6.1-in) GCT self-propelled gun that can fire at the rate of eight rounds per minute until its ammunition is exhausted; this weapon has already been exported to Iraq and Saudi Arabia. Italy, West Germany and the United Kingdom are to replace their M109s from the late 1980s with the 155-mm (6.1-in) SP-70, which is based on automotive components of the Leopard 1 MBT and will also be fitted with an automatic loading system. The introduction of artillery- and mortar-locating systems such as the American AN/TPQ-36 and AN/TPQ-37 has meant that artillery weapons can now easily be located and identified and counter-battery fire quickly brought to bear. This means that in future conflicts artillery will fire only for a short period before moving off to a new fire position, for static location will surely entail neutralization.

Self-propelled artillery weapons are of little use without the full range of fire-control aids that now include surveillance and locating radars, sound-ranging equipment, battalion and battery computers, position and azimuth determining systems, RPVs and surveillance aircraft/helicopters, laser rangefinders and meteorological stations, to name just a few.

The Israelis used the M107 widely in the 1973 Yom Kippur war and intend to keep it in service. Firing the special 40-km (24.8-mile) plus round developed for them, the long range of the 175-mm (6.89-in) gun is ideal for Israel's special requirement.

FRANCE

Mk 61 105-mm Self-Propelled Howitzer

The development by the Atelier de Construction d'Issy-les-Moulineaux of the AMX-13 light tank in the late 1940s laid the basis for one of the largest families of tracked vehicles ever developed. At an early stage the French army issued a requirement for a 105-mm (4.13-mm) self-propelled howitzer, and it was decided to base this **Mk 61** equipment on a modified AMX-13 tank chassis. After trials with prototype vehicles, the equipment was placed in production at the Atelier de Construction Roanne in the late 1950s under the designation **Obusier de 105 Modèle 50 sur Affût Automoteur** for the French army. It is still available to special order from Creusot-Loire, which now builds and markets all members of the AMX-13 light tank family. In addition to being used by the French army, it has been purchased by Morocco, Israel and the Netherlands, the last having a longer 30-calibre barrel. The type has already been phased out of service with the Israeli army, having been replaced by the 155-mm (6.1-in) M109A1; in the French army it is being replaced by the 155-mm (6.1-in) GCT self-propelled weapon.

The vehicle is of all-welded steel construction that provides the crew with protection from small arms fire and shell splinters. The engine and transmission are at the front, the driver is on the left side, and the fully enclosed gun compartment is at the rear. Access hatches are provided in the roof and rear, and the commander has a cupola with periscopes for all-round observation. The suspension is of the well-proven torsion-bar type, and consists on each side of five rubber-tyred road wheels, with the drive sprocket at the front, the idler at the rear and three track-return rollers. Hydraulic shock absorbers are provided at the first and last road wheel stations. The tracks are steel, but can be fitted with rubber pads to reduce damage to the road surface.

The 105-mm (4.13-in) howitzer has a double-baffle muzzle-brake, and can be elevated from −4° 30′ to +66°; traverse is 20° left and right. Traverse and elevation are both manual. Various types of standard 105-mm (4.13-in) separate-loading ammunition can be fired, including an HE projectile weighing 16 kg (35.3 lb) to a maximum range of 15000 m (16,405 yards) and a HEAT projectile which will penetrate 350 mm (13.8 in) of armour at an incidence of 0° or 105 mm (4.13 in) of armour at 65°. A total of 56 rounds of ammunition is carried, and of these six are normally HEAT rounds. A 7.62-mm (0.3-in) or 7.5-mm (0.295-in) machine-gun is mounted externally on the roof for anti-aircraft defence, and a similar weapon is carried inside the vehicle for use in the ground role, 2,000 rounds of ammunition being carried for these weapons. The Mk 61 does not have an NBC system, and has no amphibious capability.

One of the drawbacks of the Mk 61 is the limited traverse of the ordnance. The prototype of a similar vehicle but fitted with a turret that could be traversed through 360° was built but not placed in production, although a few were purchased for trials purposes by Switzerland. By the time the turret version was ready most countries had already decided to replace their 105-mm (4.13-in) equipment with more effective 155-mm (6.1-in) weapons, and in most cases chose the American M109. The chassis of the Mk 61 was also used for trials with the Roland surface-to-air missile system and as a minelayer, but neither of these variants entered production. A similar chassis is also used for the AMX-13 DCA twin 30-mm self-propelled anti-aircraft gun produced for the French army in the 1960s.

The Mk 61 is one of the many vehicles based on the AMX-13 light tank chassis. Obsolete by modern standards, it is still available to special order.

Specification

Crew: 5

Weight: 16500 kg (36,375 lb)

Dimensions: length 5.70 m (18 ft 8½ in); width 2.65 m (8 ft 8¼ in); height 2.70 m (8 ft 10¼ in)

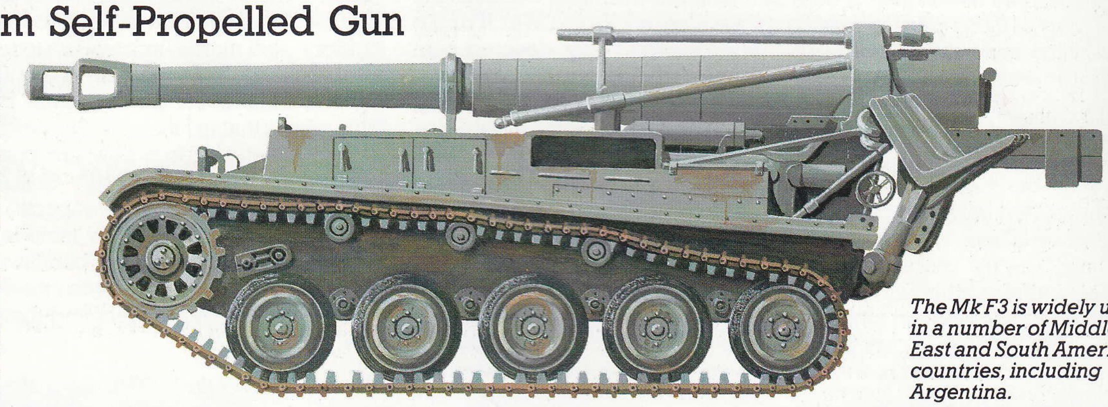
Powerplant: one SOFAM 8Gxb 8-cylinder petrol engine developing 250 hp (186 kW)

Performance: maximum road speed 60 km/h (37 mph); maximum range 350 km (217 miles); gradient 60%; vertical obstacle 0.65 (2 ft 2 in); trench 1.60 m (5 ft 3 in)

FRANCE

Mk F3 155-mm Self-Propelled Gun

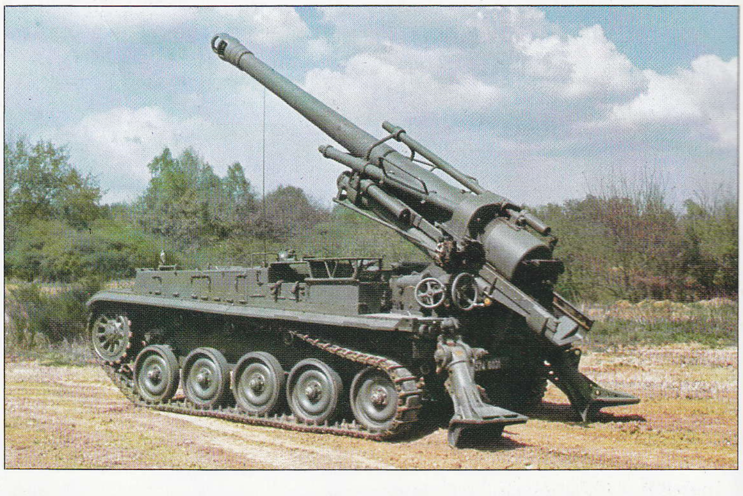
In the period immediately after World War II the standard self-propelled howitzer of the French army was the American 155-mm (6.1-in) M41 Howitzer Motor Carriage, essentially the M24 Chaffee light tank chassis fitted with a slightly modified version of the standard M114 towed howitzer. This was replaced in the 1960s by the 155-mm (6.1-in) **Mk F3** self-propelled gun, which is basically a shortened AMX-13 light tank chassis with 155-mm (6.1-in) gun mounted at the rear of the hull. The ordnance is based on the Modèle 50 towed weapon of the same calibre. In addition to being used by the French army, the Mk F3 is used by Argentina, Chile, Ecuador, Kuwait, Morocco, Qatar, Sudan, United Arab Emirates and Venezuela. It will be replaced in the late 1980s in French service by the 155-mm (6.1-in) GCT. Production of the Mk F3, along with other members of AMX-13 light tank family, was originally undertaken at the Atelier de Construction Roanne, a French government facility, but as this plant tooled up for production of the AMX-30 MBT, AMX-30 variants and the AMX-10P family, production of the whole AMX-13 family, including the Mk F3, was transferred to Creusot-Loire at Châlon-sur-Saône, where production continues today, although at a much lower rate.



The Mk F3 is widely used in a number of Middle East and South American countries, including Argentina.

The 155-mm (6.1-in) ordnance is mounted at the very rear of the chassis and can be elevated from 0° to +67°, with a traverse of 20° left and right up to an elevation of +50° and of 16° left and 30° right from +50° up to the maximum elevation. Elevation and traverse are both manual. When travelling the ordnance is held in a travel lock and traversed 8° to the right. The 33-calibre barrel has a double-baffle muzzle-brake and a screw breech mechanism. Ammunition is of the separate-loading type, and the following can be fired: high explosive with a maximum range of just over 20000 m (21,875 yards), illuminating and smoke to a range of 17750 m (19,410 yards), and a rocket-assisted projectile to a range of 253300 m (27,670 yards). Rate of fire for the first few minutes is three rounds per minute, but when the Mk F3 is used in the sustained fire role the rate is one round a minute. Before firing commences two spades are manually released at the rear of the hull and the vehicle then reversed backwards to provide a more stable firing platform.

A major disadvantage of the Mk F3 (in addition to the total lack of protection for the gun and its crew) is that only the driver and commander can be carried in the actual vehicle. The remainder of the gun crew are carried in an AMX VCA (Véhicule Chenillé d'Accompagnement, or tracked support vehicle) or 6×6 truck which also carries 25 projectiles, charges and associated fuzes. The VCA can also tow an



The Mk F3 in firing position with its recoil spade down. The total lack of gun and crew protection is self-evident.

ARE 2-tonne F2 ammunition trailer which carries an additional 30 projectiles and charges.

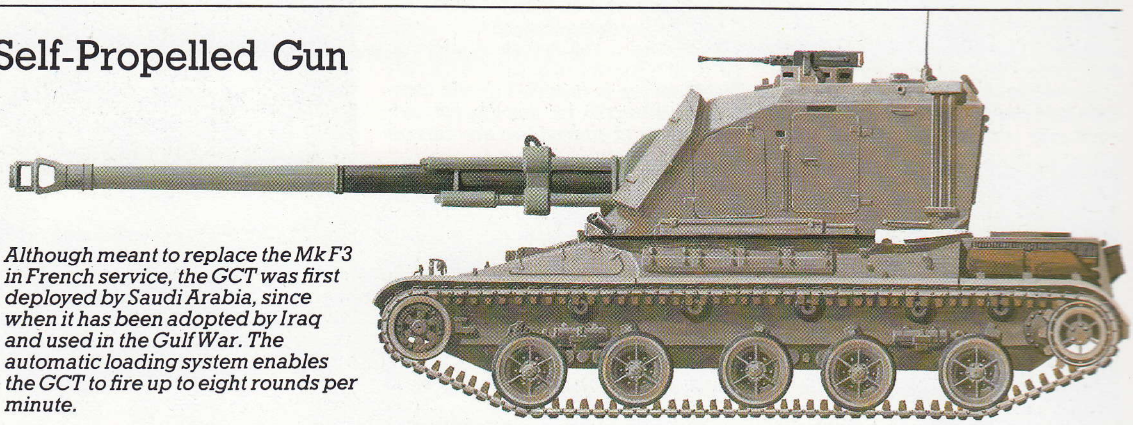
The Mk F3 can ford to a depth of 1 m (3 ft 3 in) but has no NBC system; active or passive night-vision equipment can be installed, and all vehicles have direct and indirect sights, and a loudspeaker and cable. The basic vehicle is powered by a petrol engine, but if required this can be replaced by a General Motors Detroit Diesel 6V-53T developing 280 hp (209 kW). This produces a slightly higher road speed and, most important of all, an increased operational range from 300 to 400 km (185 to 250 miles).

Specification

Crew: 2
Weight: 17400 kg (38,360 lb)
Dimensions: length (gun forward) 6.22 m (20 ft 5 in); width 2.72 m (8 ft 11 in); height 2.085 m (6 ft 10 in)
Powerplant: one SOFAM 8Gxb 8-cylinder petrol engine developing 250 hp (186 kW)
Performance: maximum road speed 60 km/h (37 mph); maximum range 300 km (185 miles); gradient 40%; vertical obstacle 0.60 m (2 ft 0 in); trench 1.50 m (4 ft 11 in)

FRANCE

GCT 155-mm Self-Propelled Gun



Although meant to replace the Mk F3 in French service, the GCT was first deployed by Saudi Arabia, since when it has been adopted by Iraq and used in the Gulf War. The automatic loading system enables the GCT to fire up to eight rounds per minute.

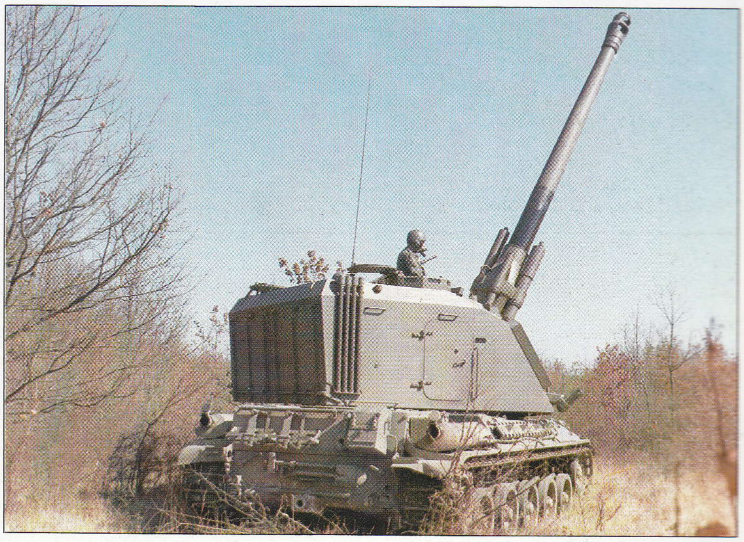
For many years the standard self-propelled weapons of the French army have been the 155-mm (6.1-in) Mk F3 and the 105-mm (4.13-in) Mk 61. The former suffered a major disadvantage in that its weapon was in an unprotected mount with limited traverse and most of the gun crew had to be carried in another full-tracked vehicle that also carried the ammunition. In the late 1960s a new self-propelled gun called the **GCT** (Grande Cadence de Tir) was developed on a slightly modified AMX-30 MBT chassis. The first prototype was completed in 1972, and following trials with a pre-production batch of 10 vehicles production got under way in 1977. For a number of reasons Saudi Arabia was the first country to deploy the GCT; they ordered 51 systems plus a complete fire-control system. The French army designates the GCT the **155 AU F1**, and deploys it in regiments of 18 weapons (three batteries each with six GCTs). More recently Iraq has placed an order for 85 GCTs, and these are now being delivered. The GCT is manufactured at the Atelier de Construction Roanne with the assistance of many other GIAT establishments all over France.

As mentioned above, the chassis is similar to that of the AMX-30 MBT but with a new all-welded turret in the centre fitted with a 155-mm (6.1-in) 40-calibre barrel that has a multi-baffle muzzle-brake and a vertical sliding wedge breech block. Elevation is from −4° to +66° at a rate of 5° per second, and turret traverse is 360° at the rate of 10° per second. Turret traverse and gun elevation are hydraulic, with manual controls for emergency use.

The major feature of the GCT is the automatic loading system for a total of 42 projectiles and a similar number of cartridges carried in racks in the turret rear. Ammunition mix depends on the tactical situation, but can consist of 36 (six racks of six) HE and six (one rack of six) smoke projectiles. Access to the ammunition racks for reloading purposes is via two large turret doors in the rear. The four-man crew can reload the GCT in 15 minutes, and if required loading can be undertaken while the weapon is being fired. The automatic loading system enables a rate of eight rounds per minute, and the gunner can select either single shots or six-round bursts, the latter taking just 45 seconds. When manual loading is used, two to three rounds per minute can be fired.

The following projectiles can be fired by the GCT: high explosive, illuminating, smoke and rocket-assisted. The last has a range of 30500 m (33,355 yards) and has been developed by Thomson-Brandt. More advanced projectiles are now under development for the GCT and the towed equivalent, the TIR, including a round carrying six anti-tank mines. The ordnance can also fire the American Cannon-Launched Guided Projectile (CLGP), although this has not yet been accepted by the French army.

A 7.62-mm (0.3-in) or 12.7-mm (0.5-in) machine-gun is mounted on the turret roof for anti-aircraft defence, and two electrically-operated smoke-dischargers are mounted on each side of the turret. Standard equipment of all vehicles includes night-vision equipment and a ventilating system, while optional equipment includes an NBC pack, muzzle velocity measuring equipment and various fire-control devices. For trials purposes the turret of the GCT has also been fitted to the Leopard 1 MBT chassis but this combination has not so far been adopted by any country.



The GCT is seen here with its ordnance at its maximum elevation of 66 degrees.

Specification

Crew: 4
Weight: 42000 kg (92,595 lb)
Dimensions: length (gun forward) 10.25 m (33 ft 7½ in); length (hull) 6.70 m (22 ft 0 in); width 3.15 m (10 ft 4 in); height 3.25 m (10 ft 8 in)
Powerplant: one Hispano-Suiza HS 110 12-cylinder water-cooled multi-fuel engine developing 720 hp (537 kW)
Performance: maximum road speed 60 km/h (37 mph); maximum range 450 km (280 miles); gradient 60%; vertical obstacle 0.93 m (3 ft 0⅔ in); trench 1.90 m (6 ft 3 in)

USA

M52 105-mm Self-Propelled Howitzer

The **M52** 105-mm (4.13-in) self-propelled howitzer was developed to meet the requirements of the United States Field Artillery in the period immediately after World War II, and uses many automotive components common to the M41 light tank. Production started in 1951 at the Detroit Tank Arsenal under the designation **T98E1**, this being standardized subsequently as the M52. From the early 1960s the weapon was replaced by the 105-mm (4.13-in) M108, which itself was soon replaced by the 155-mm (6.1-in) M109 self-propelled howitzer based on the same chassis as the M108. The main reasons for the replacement of the M108 and M52 by the M109 was the latter's 155-mm (6.1-in) projectile, which is much heavier and has a greater HE content, and is therefore considerably more effective. It also has the longer range of 14000 m (15,310 yards) and can fire a wider selection of ammunition, eventually including tactical nuclear ammunition. Another advantage of the M109 over the M52 is

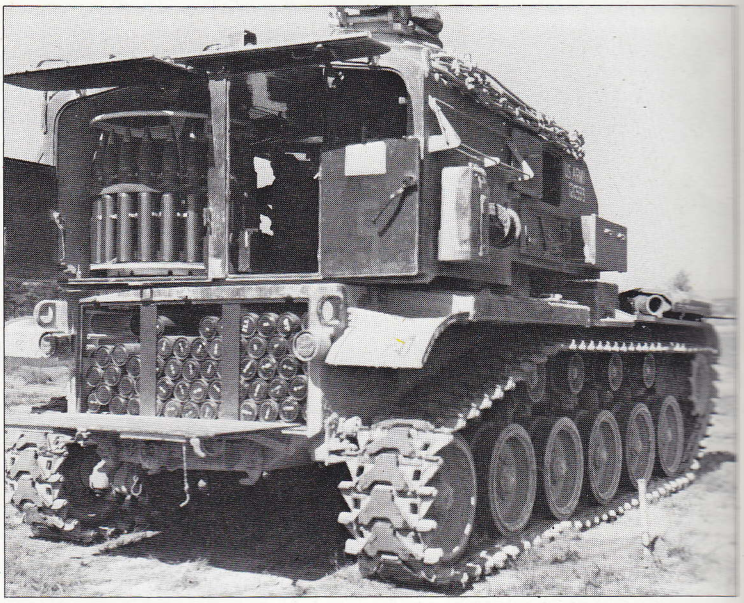
Although replaced in US Army service by the M109 series, the M52 can still be found in a number of NATO and Far Eastern countries.

its greater operating range of 390 km (240 miles) thanks to the use of a diesel engine.

The M52 has long been replaced in US army service by the M108 and M109, but is still used by Belgium, Greece, Italy, Japan, Spain and Turkey.

The hull and turret of the M52 are of 12.7-mm (0.5-in) welded steel armour, with the engine and transmission at the front of the hull and the turret at the rear. Suspension is of the torsion-bar type, and consists of six road wheels on each side with the rearmost of these acting as the idler; the drive sprocket is at the front and there are four return rollers. The fully enclosed turret is at the rear and is unusual in that it accommodates the driver. The turret can be traversed 60° left and right. Main armament consists of the 105-mm (4.13-in) M49 howitzer with an elevation of +65° and a depression of −10°; elevation/depression and turret traverse are manual. The M49 has a very short barrel, and a total of 102 rounds of ammunition is carried, of which 21 rounds are located in a vertically-mounted revolver-type rack (commonly called the Lazy Susan) at the left rear of the turret. Additional ammunition is stowed in the turret and under the hull at the rear. The 105-mm (4.13-in) howitzer has a maximum range of 11270 m (12,325 yards). The howitzer was cleared to fire the following types of ammunition (not all of these are used today): chemical, anti-personnel, high explosive, high explosive plastic, high explosive rocket-assisted (with a range of 15000 m/16,400 yards), leaflet, illuminating, smoke, and tactical CS. Both direct (anti-tank) and indirect sights are fitted, although the former would only be used as a last resort. A 12.7-mm (0.5-in) Browning anti-aircraft machine-gun is mounted on the commander's cupola for anti-aircraft use; 900 rounds of ammunition are carried for this weapon.

Standard equipment includes a heater, a turret-mounted ventilator (essential to remove fumes from the turret when the ordnance is fired), an auxiliary generator so that the batteries will not quickly run down, a bilge pump and a fixed fire-extinguishing system. The M52 has no NBC system and no amphibious capability, although it can ford to a depth of 1.219 m (4 ft), but some vehicles have been fitted with infra-red driving lights.



Specification

Crew: 5

Weight: 24040 kg (53,000 lb)

Dimensions: length 5.80 m (19 ft 0⅓ in); width 3.149 m (10 ft 4 in); height (with AA MG) 3.316 m (10 ft 10¼ in)

Powerplant: one Continental AOS-895-3 6-cylinder petrol engine developing 500 hp (373 kW)

Performance: maximum road speed 56.3 km/h (35 mph); maximum range 160 km (100 miles); gradient 60%; vertical obstacle 0.914 m (3 ft 0 in); trench 1.828 m (6 ft 0 in)

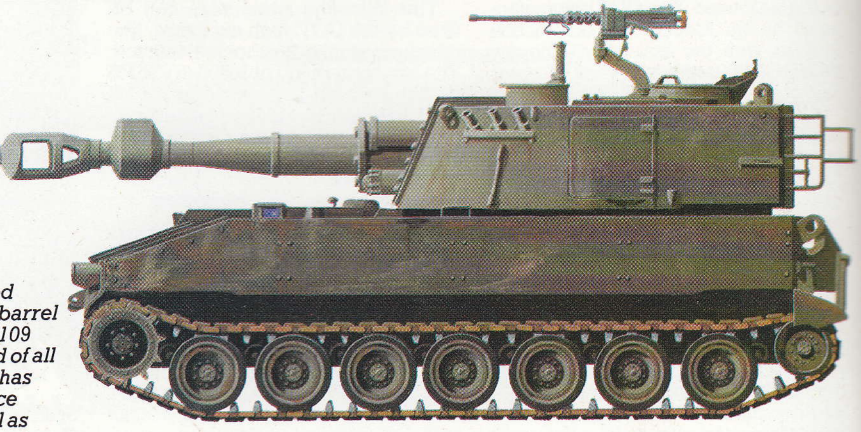
The extensive stowage spaces for reserve ammunition and the turret revolver-type 'Lazy Susan' 21-round ready-use rack can clearly be seen in this rear view of a US Army M52. It was about to fire on an exercise in 1959.

USA

M109 155-mm Self-Propelled Howitzer

The **M109** 155-mm (6.1-in) self-propelled howitzer is the most widely used self-propelled artillery weapon in the world today. Its development can be traced back to 1952, when the requirement was issued for a new self-propelled howitzer to replace the 155-mm (6.1-in) M44. At that time the 110-mm (4.33-in) T195 self-propelled howitzer was already being designed, and it was decided to use its hull and turret as the basis for the new weapon, which would be armed with a 156-mm (6.14-in) howitzer. But in 1956 it was decided to stick to a 155-mm (6.1-in) calibre for commonality in NATO, and in 1959 the first prototype was completed under the designation **T196.** There were numerous problems with this equipment, and much redesign work had to be carried out to improve its reliability. At the same time a decision was taken that all future American AFVs would be powered by diesel engines for greater operating range, so the vehicle was redesignated **T196E1** with such a powerplant. In 1961 this was accepted for service as the M109 self-propelled howitzer, and the first production vehicles were completed in late 1962 at the Cleveland Army Tank Plant, this facility being run by the Cadillac Motor Car Division. At a later date the plant was run by Chrysler, but in the 1970s all production of the M109 series was taken over by Bowen-McLaughlin-York (BMY), where production of the latest version continues today.

In the United States Army the M109 is issued on the scale of 54 per armoured and mechanized division (three battalions each of 18 vehicles, each battalion having three batteries of six M109s). In addition to the US Army and US Marine Corps, the M109 is used by Austria, Belgium, Canada, Denmark, Ethiopia, West Germany, Greece, Iran, Israel, Italy, Jordan, Kampuchea, Kuwait, Libya, Morocco, the Netherlands, Norway, Oman, Pakistan, Peru, Portugal, Saudi Arabia, South Korea, Spain, Switzerland, Taiwan, Tunisia, Turkey and the United Kingdom. It has been used in action in a number of conflicts in the Middle East (by Iran and Israel) and the Far East (by the USA in Vietnam and by Kampuchea).



The basic M109 self-propelled howitzer mounting the short barrel M126 howitzer barrel. The M109 series is the most widely used of all self-propelled weapons and has seen extensive combat service throughout the world, as well as seeing constant adaptation and updating.

The hull and turret of the M109 are of all-welded aluminium construction. The driver is seated at the front on the left, with the engine compartment to his right, and the turret is at the rear. The suspension is of the well-tried torsion-bar type, and consists of seven road wheels with the drive sprocket at the front and the idler at the rear; there are no track-return rollers. Standard equipment includes infra-red driving lights and an amphibious kit enabling the vehicle to propel itself across slow-flowing rivers with its tracks.

The M109 has a 155-mm (6.1-in) howitzer M126 with an elevation of +75° and a depression of −5°. Turret traverse is 360°, and both gun elevation and turret traverse are powered, with manual controls available for emergency use. The ordnance has a large fume extractor, large muzzle-brake and a Welin-step thread type breech block. Normal rate of fire is one round per minute, but for short periods three rounds per minute can be attained. The weapon can fire a wide range of projectiles including high explosive (maximum range 14320 m/15,660 yards), illuminating, tactical nuclear, smoke, tactical CS and Agents VX or GB. A total of 28 projectiles and charges is carried. A 12.7-mm (0.5-in) M2HB machine gun is mounted on the commander's cupola for anti-aircraft defence, and 500 rounds are provided for this weapon.

One of the reasons that the M109 has been in production for so long is that its basic chassis has proved capable of constant updating and of accepting longer-barrelled ordnance that fires projectiles to a greater distance.

Specification

Crew: 6

Weight: 23786 kg (52,440 lb)

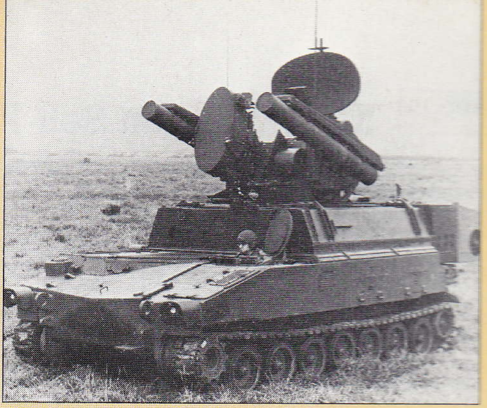
Dimensions: length (gun forward) 6.612 m (21 ft 8¼ in); length (hull) 6.256 m (20 ft 6¼ in); width 3.295 m (10 ft 9¾ in); height 3.289 m (10 ft 9½ in)

Powerplant: one Detroit Diesel Model 8V-71T diesel developing 405 bhp (302 kW)

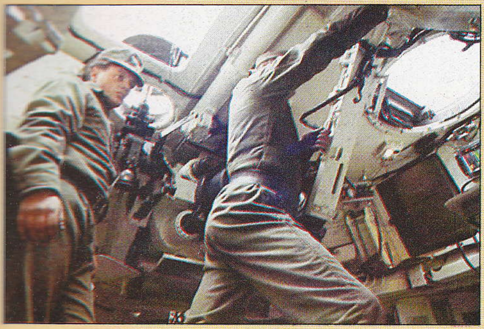
Performance: maximum road speed 56 km/h (35 mph); maximum range 390 km (240 miles); gradient 60%; vertical obstacle 0.533 m (1 ft 9 in); trench 1.828 m (6 ft 0 in)

The M109 Family

Since the first M109 was issued to the US Army in 1963 the design has undergone a number of improvements, and has been used as the basis for several other vehicles. The first improvement was the longer barrel conversion kit for the M109A1 that entered service in 1973. This was followed in 1979 by a major redesign model, the M109A2, with extra stowage for 22 additional rounds of ammunition. In the late 1970s and early 1980s the XM965 missile launcher and the XM992 Ammunition Resupply and Fire Direction Centre vehicles were developed. Further improvements to the M109 are in view, under the Howitzer Extended Life Program (HELP).



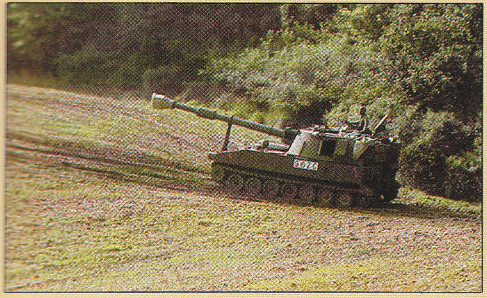
The XM 975 tracked carrier for the US version of the European Roland SAM missile system is shown with the Fire Unit Module in place.

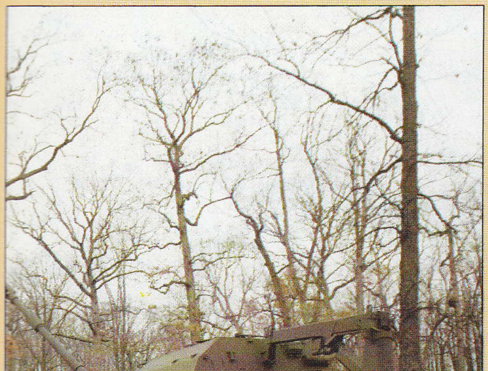


Above: An interior view of a British M109, showing the breech end and ammunition loading system.

Right: British Army of the Rhine M109s on exercise are visible through the muzzle brake of another.

Below: The latest configuration of one of the Howitzer Extended Life Program test vehicles being evaluated as part of the US Army's Divisional Support Weapons programme.





Left: The M992 Field Artillery Ammunition Support (FAASV) will be used from 1983 onwards to carry 118 extra rounds per vehicle for the US Army M109 units.

Above: A pair of British M109s located in woods during a field exercise in West Germany. BAOR operates most British M109s.

USA

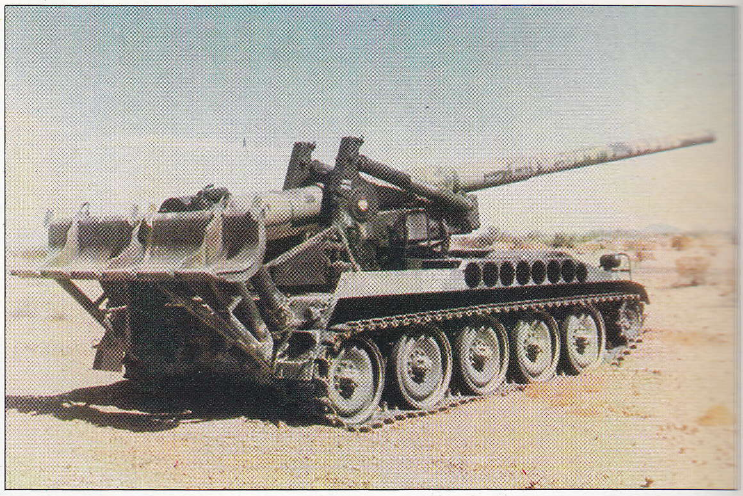
M107 175-mm Self-Propelled Gun

In the 1950s the standard 203-mm (8-in) self-propelled howitzer of the US Army was the M55, which had the chassis and turret of the M53 155-mm (6.1-in) self-propelled gun. The main drawbacks of both these weapons were that at a weight of about 45 tons they were too heavy for air transport and their petrol engines gave them an operating range of only 260 km (160 miles). In the mid-1950s a decision was taken to design a new family of self-propelled artillery that would share a common chassis and mount, be air-portable, and come into and be taken out of action quickly. Prototypes were built by the Pacific Car and Foundry Company under the designations 175-mm (6.89-in) self-propelled gun **T235**, 203-mm (8-in) self-propelled howitzer T236, and 155-mm (6.1-in) self-propelled gun T245. Further development, including the replacement by diesels of the petrol engines for increased operational range, resulted in the T235 being standardized as the **M107** and the T236 as the M110. The chassis of the family was also used as the basis for a number of armoured recovery vehicles (ARVs) but in the end only the T120E1 was placed in production as the M578 light ARV; this serves with many countries including the United States.

Production of the M107 was undertaken initially by the Pacific Car and Foundry Company, the first vehicles being completed in 1962 and the first battalion forming at Fort Sill (home of the US Field Artillery) in early 1963. At a later date production was also undertaken by FMC, and from 1965 to 1980 by Bowen-McLaughlin-York.

The US Army deployed the 175-mm (6.89-in) M107 in 12-gun battalions at corps level but in recent years all of these weapons have been converted to the 203-mm (8-in) M1102 configuration as this has a range of just over 29000 m (31,715 yards) with a HERA (High Explosive Rocket Assist) projectile. The M107 was also exported to Greece, Iran, Israel, Italy, South Korea, the Netherlands, Spain, Turkey, the United Kingdom and West Germany; many of these countries are now also converting their M107s to the M110A2 configuration.

The chassis of the M107 is fully described in the entry for the M110. The 175-mm (6.89-in) gun has an elevation of +65° and a depression of −2° and traverse is 30° left and right. Traverse and elevation are powered, although manual controls are provided for emergency use. Only one round was ever standardized for US Army use, the HE M437A1 or M437A2 which with a charge three propellant had a maximum range of 32700 m (35,760 yards), although a special round is used by Israel with a range of some 40000 m (43,745 yards). To assist the crew in loading the 66.78-kg (147-lb) projectile, a rammer and loader assembly is mounted at the rear of the chassis. This lifts the projectile from the ground, positions in and then rams it into the chamber. The charge is then loaded and the ordnance fired. Only two projectiles and charges are carried on the M107, which has a total crew of 13, of whom five (driver, commander and three gunners) travel on the M107. The remainder are carried in the M548 tracked cargo carrier that also carries the bulk of the ammunition. Some countries use 6×6 trucks to support the M107, but often these have poor cross-country mobility compared with the M107. The M107 is normally fitted with infra-red night-vision equipment, but does not have an NBC system. It has no amphibious capability although it can ford to a depth of 1.066 m (3 ft 6 in).



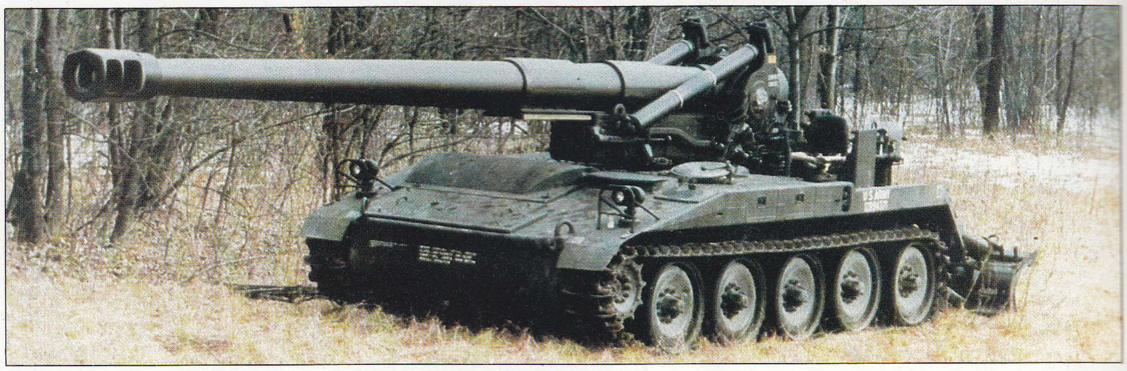
A US Army M107 in travelling order. All of these vehicles have now been converted to the M110A2 configuration by replacing the 175-mm (6.8-in) gun.

Specification

Crew: 5+8
Weight: 28168 kg (57,690 lb)
Dimensions: length (gun forward) 11.256 m (36 ft 7¾ in); length (hull) 5.72 m (18 ft 9 in); width 3.149 m (10 ft 4 in); height 3.679 m (12 ft 0 in)
Powerplant: one Detroit Diesel Model 8V-71T diesel developing 405 hp (302 kW)
Performance: maximum road speed 56 km/h (35 mph); maximum range 725 km (450 miles); gradient 60%; vertical obstacle 1.016 m (3 ft 4 in); trench 2.326 m (7 ft 9 in)

USA

M110 203-mm Self-Propelled Howitzer



The **M110** 203-mm (8-in) self-propelled howitzer uses the same chassis and mount as the 175-mm (6.89-in) M107 self-propelled gun and details of its development are given in the entry for the M107. The M110 entered service with the US Army Field Artillery in 1963, and is issued today on the scale of one battery of four per infantry division and one battalion of 12 for each armoured and mechanized division. Production was originally completed in the late 1960s but was resumed in the 1970s by Bowen-McLaughlin-York (BMY) and the latest models remain in current production. In addition to being used by the US Army and US Marines, the M110 is operated by Belgium, Greece, Iran, Israel, Italy, Japan, Jordan, the Netherlands, Pakistan, Saudi Arabia, South Korea, Spain, Taiwan, the United Kingdom and West Germany. This list includes those on order and in many cases, especially in Europe, the M110s are being upgraded with the aid of kits supplied by the United States.

The chassis of the M110 is of all-welded steel construction with the driver seated under armour on the front at the left, with the engine compartment to his right and the howitzer on its mount on top of the chassis at the rear. Suspension is of the torsion-bar type and consists of five large road wheels with the rearmost acting as the idler; the drive sprocket is at the front and there are no track-return rollers. The suspension can be locked when the M110 is in the firing position to provide a more stable firing platform.

The 203-mm (8-in) M2A2 howitzer was developed well before World War II and is located on the mount M158, this allowing an elevation of +65° and a depression of −2°, with traverse 30° left and right. Elevation and traverse are hydraulic, with manual controls for emergency use. The M2A2 has no muzzle brake or fume extractor and has an interrupted screw breech block. At the rear of the chassis is a rammer and loader assembly to lift the projectile from the ground, position it and ram it into the chamber. The following projectiles can be fired: high explosive (weight 92.53 kg/204 lb to a maximum range of 16800 m/18,375 yards), high explosive (carrying 104 or 195 grenades), Agents GB or VX, and tactical nuclear. Only two projectiles and charges are carried on the M110, others being provided from the M548 carrier that also transports the remainder of the crew. The complete crew of the M110 consists of 13 men,of whom five (commander, driver and three gunners) are on the actual vehicle.

One of the main drawbacks of the M110 is the complete lack of any protection for the gun crew from shell splinters, small arms fire and NBC agents. A protection kit is being developed and is expected to be fielded soon.

All American M110s have now been upgraded to **M110A1** or **M110A2** standard. The former has a longer barrel and fires an HE projectile to a maximum range of 21300 m (23,300 yards) or a HE rocket-assisted projectile to 29100 m (31,825 yards); other rounds available are Improved Conventional Munitions, Agents GB or VX. Binary or tactical nuclear. The **M110A2** is almost identical to the M110A1 but has a muzzle-brake which enables it to fire charge nine of the M118A1 propelling charge whereas the M110A1 can go only up to charge eight.

A US Army M110A2. This differs from previous M110 versions in having a long, muzzle-braked barrel. All of the M110 series in the US Army will eventually be fitted with a crew shelter and NBC system, to rectify the original lack of cover for the gun crew.

Specification

Crew: 5+8
Weight: 26536 kg (58,500 lb)
Dimensions: length (gun forward) 7.467 m (24 ft 6 in); length (hull) 5.72 m (18 ft 9 in); width 3.149 m (10 ft 4 in); height 2.93 m (9 ft 7¼ in)
Powerplant: one Detroit Diesel Model 8V-71T diesel developing 405 bhp (302 kW)
Performance: maximum road speed 56 km/h (35 mph); maximum range 725 km (450 miles); gradient 60%; vertical obstacle 1.016 m (3 ft 4 in); trench 2.362 m (7 ft 9 in)

M107/110 in Action

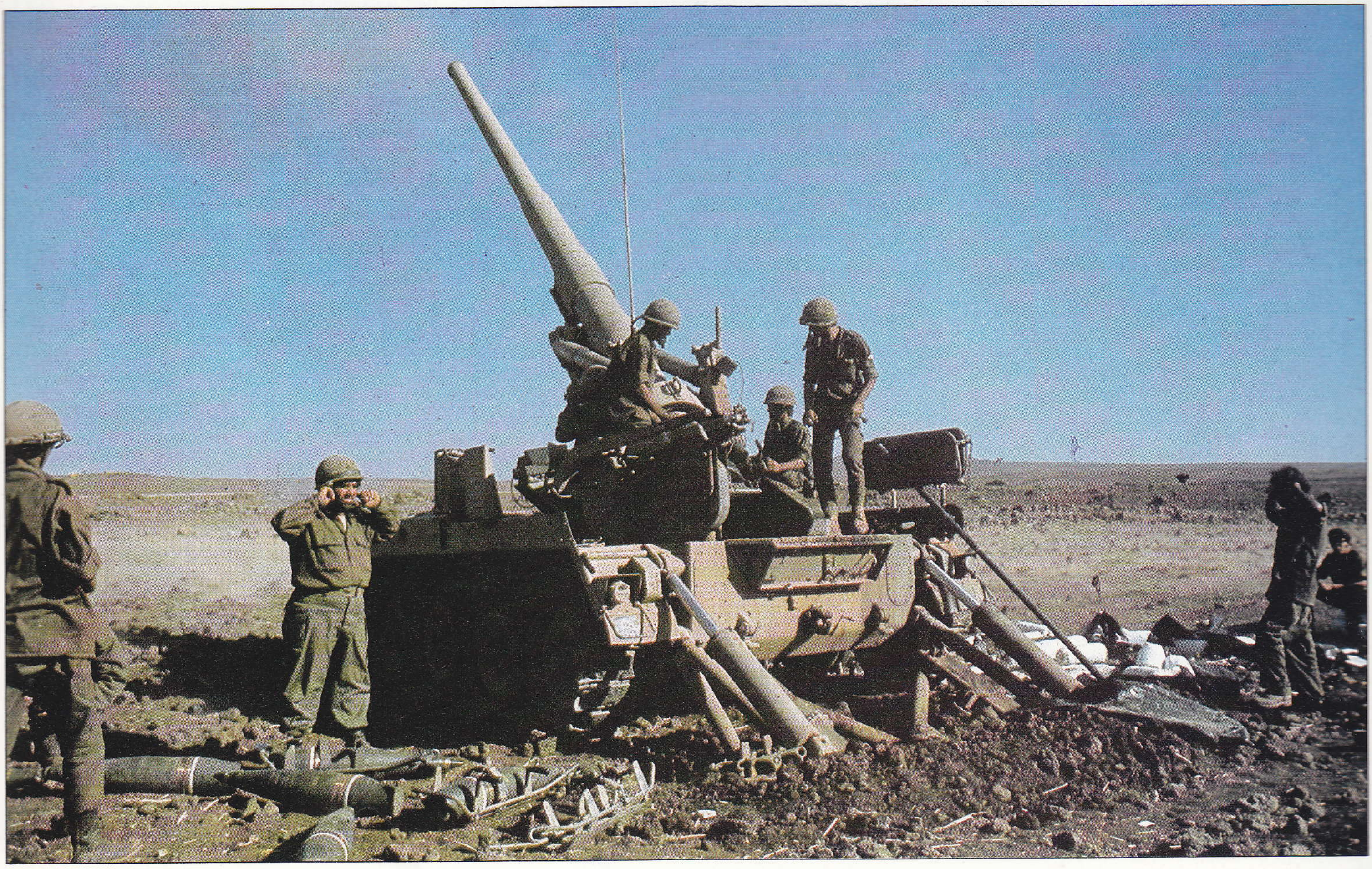
The 175-mm M107 and 203-mm M110 series were designed as complementary artillery pieces and have seen extensive service in the Middle East, Vietnam and Gulf wars. In Vietnam they tended to be used as fixed pieces firing from prepared positions, whilst in the other conflicts their fire-and-move abilities have been utilized to the full.

The 175-mm (6.89-in) M109 and 203-mm (8-in) self-propelled weapons were used by the Israeli army in the 1973 Middle East war (on both the southern and northern fronts) and during the invasion of the Lebanon in the summer of 1983. It is also believed that Iran took delivery of eight M107s and 38 M110s before the downfall of the Shah and that these have been used in the recent Gulf War. Few details of the weapons' uses in the latter campaign are available at present, although from all accounts the M107 has proved to be one of the most effective weapons in the Iranian arsenal.

Israel took delivery of about 80 M107s and 48 M110s in the early 1970s, and while almost every country is now updating its M107s to the M110A1/M110A2 standard, so far as is known Israel intends to retain all its M107s as they are. The basic M110 fires an HE projectile to a maximum range of 16800 m (18,375 yards), the M107 an HE projectile to a maximum range of 32700 m (35,760 yards) and the M110A2 an HE projectile to a maximum range of 21300 m (23,300 yards) or a rocket-assisted projectile (officially called HERA, for High Explosive Rocket Assist) to a range of 29100 m (31,825 yards). This leaves only a 10 per cent range difference between the M107 and M110A2, a factor balanced in some respects by the heavier round of the M110A2: this weighs 90.72 kg (200 lb) compared with 66.78 kg (147.2 lb) for the M107's projectile, and is therefore more powerful. In addition, of course, the M110A2 can fire specialized rounds such as tactical nuclear, Agent (GB or VX), binary or the M509 Improved Conventional Munition (ICM) that carries no fewer than 195 M42 grenades, which have a devastating effect on light vehicles and unprotected troops.

The Israeli army has a special round for the M107 not used by any other country. This was developed in Canada by the now defunct Space Research Corporation (SRC) and is called the 175-mm (6.89-in) Extended-Range Sub-Calibre Projectile Mk 1 Mod 7 (ERSC). This projectile weighs 56 kg (123.5 lb) including the sabot, and carries 4.67 kg (10.3 lb) of high explosive compared with 13.6 kg (30 lb) in the normal M437A1 HE round, but has a range of about 40000 m (43,750 yards), so outranging all the Soviet artillery weapons supplied to Syria, including the 180-mm (7.09-in) S-23 with a maximum range of 30400 m (33,245 yards) and the old but highly effective 130-mm (5.12-in) M-46 with a range of 27150 m (29,690 yards), or more with a rocket-assisted projectile.

The main problem with artillery weapons such as the M107 and M110A2 is that of locating the designated target, as they are normally well beyond the visual range of forward observation officers. The targets are normally detected by drones (RPVs), aircraft and helicopters (but often only when air superiority has been established and ground-based air-defence systems neutralized), sound ranging or other electronic systems. The weapons can engage static targets such as known bridging sites, command centres, major road junctions and airfields. The M107 was used by the Israeli army to keep Damascus airport closed on a number of occasions during the 1973 Middle East war. At such long range the weapons cannot hit the target with the same pinpoint accuracy as is possible at shorter ranges. They also suffer from the major disadvantage of having a low rate of fire of about two rounds a minute for a short period, or one round a minute for sustained periods. When these weapons were originally developed in the 1950s they normally remained in a static fire position for some time as they were so far behind the front line that they were difficult to locate, even by sound ranging. The rapid introduction of highly accurate and sophisticated mortar- and artillery-locating radars (for example the American AN/TPQ-36 mortar-locating and AN/TPQ-37 artillery-locating radars) has meant that it is possible to pinpoint the exact position of the ordnance before the projectile has even reached its target. This information is then passed to friendly artillery, rocket-launchers or aircraft, and the battery is engaged. For this reason in any future conflict it is expected that artillery weapons will fire just a few rounds before they move off to a new fire position. This is also why more recent artillery systems, such



This Israeli M107 has just fired, the recoil spade digging into the earth to absorb the tremendous recoil forces.

Above: Firing HE shells, this US Army M107 was used to support ground forces during an April 1968 offensive in the A Shau valley region of South Vietnam.

Left: In spite of their long range, the enemy can still hit back. An Israeli M107 battery during the 1973 war has been hit by an Egyptian air strike.

as the French 155-mm (6.1-in) GCT (in service with the French, Iraqi and Saudi Arabian armies), have an automatic loading system that allows them to fire up to eight rounds a minute until on-board ammunition is expended. Another drawback of the M107 and M110 is that the crew have no protection at all against bad weather, small arms fire, shell splinters and NBC agents. Only two projectiles can be carried on the M107, the remainder of the crew and ammunition being carried in the FMC M548 tracked cargo carrier, which has no armour protection at all.

On the Sinai (southern) front, Israeli artillery fire in 1973 achieved some early success, but once the east bank of the Suez Canal had been secured by the Egyptian army and the Bar Lev Line neutralized, the Israeli artillery lost most of its forward observers. Most of the artillery was well to the rear of the Bar Lev Line, and could quickly be moved from one part of the front to the required area as a wide road had been built parallel to the canal and to its rear. Israeli aircraft did pinpoint the position of the pontoon bridges across the canal and attacked them with heavy losses. As soon as one section of the Soviet-supplied PMP ribbon bridge was damaged by artillery fire or bombs the Egyptians simply took out the damaged section and replaced it with a new one.

Since the 1973 Middle East War Israel has placed a great deal of emphasis on the design, development and production of RPVs for a variety of roles: Israel Aircraft Industries has produced the Scout, and Tadiran Israel Electronics Industries the Mastiff. Both of these were used during the 1982 invasion of the Lebanon for a variety of roles including target acquisition, electronic warfare and post-strike analysis. They were also used as decoys for SAMs, so allowing the following strike aircraft to be given the exact position of the SAM systems.

Israel Military Industries is known to make the 155-mm (6.1-in) ammunition for the L-33 and M109 self-propelled howitzers, and it now probably makes ammunition for the M110. As the Space Research Corporation is no longer in existence, it is most probable that ERSC ammunition is also now made in Israel.

Almost all the artillery fire-control systems used by the Israeli Army are now produced locally, including the Rafael DAVID battery computer systems and the Rafael gun display systems. The former is used at battery level and is normally mounted in an M577 command post vehicle to calculate all of the fire information for up to six guns or howitzers (for example, target bearing in azimuth and elevation, projectile type and charge, muzzle velocity and so on). This information is then transferred to the gun by the gun display system, which consists of three main parts, the actual display mounted on the weapon, the communications system and the message centre for generating and receiving messages in the DAVID. Once the information has been transmitted to the gun, the gun display unit can start transmitting reports and information back to the command centre (for example ready to fire, weapon fire, mis-fire, acknowledgement of new command, and number of projectiles remaining for completion of mission).

New 203-mm projectiles

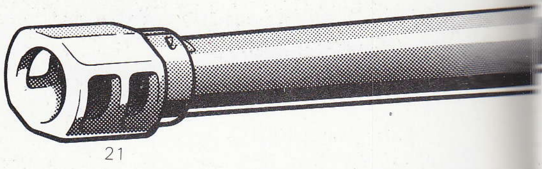
It is only within recent years that the full potential of artillery has been realized with the introduction of locating radars, RPVs, battery computers and other command and communications equipment. Much work has also been carried out in the areas of projectiles and their associated fuses. For many years the high explosive round was the standard projectile for the 203-mm (8-in) howitzer, but one of the more recent projectiles is the M509 Improved Conventional Munition (ICM) which carries 195 M42 dual-purpose grenades and the M404 which carries 104 M43A1 anti-personnel grenades. More advanced projectiles are now under development for the M110A2, including the Extended-Range Guided Projectile (ERGP) and the Sense and Destroy Armor (SADARM) projectile. Two ERGPs are being developed: one that will home onto enemy radars (for example radars that operate as part of an air-defence system) and the other a semi-active laser (SAL) homing type. Both could have a range of 40000 m (43,750 yards) or more.

The SADARM is now in advanced development by Honeywell and Aerojet Electrosystems. Basically, a 203-mm (8-in) projectile will contain three SADARMs, which are ejected over the target area, typically a concentration of tanks or other armoured vehicles. Each of the sub-munitions has a sensor that scans the target area as it descends on its parachute. When a target is detected the warhead launches a self-forging fragment which strikes and penetrates the target on its upper surface, the weakest part of a tank. The sensor is so sophisticated that it can differentiate between a truck and an armoured vehicle, and attack only the latter. The SADARM projectile, to have a range of 25000 to 30000 m (27,340 to 32,800 yards), will be deployed by the US Army and US Marine Corps at the end of the decade. It is expected that similar projectiles will be developed for 155-mm (6.1-in) weapons such as the towed M198 and self-propelled M109A2.

SP artillery in Vietnam

The US Army used a wide range of artillery weapons in Vietnam, including relatively small numbers of 175-mm (6.89-in) M107s and 203-mm (8-in) M110s. The most common weapons were the 105-mm (4.13-in) M101 and M102 towed howitzers, the 155-mm (6.1-in) M114 towed howitzer, the 105-mm (4.13-in) M108 and 155-mm (6.1-in) M109 self-propelled howitzers, and the twin 40-mm M42 self-propelled anti-aircraft gun. In most cases these were used in the static fire role, each camp having one or two batteries of guns (105-mm/4.13-in and 155-mm/6.1-in), while some of the smaller camps just had two guns.

When in the static fire position the M107s and M110s were heavily protected, with a sandbag breastwork to their front, and ammunition and crew shelters to the rear, so that the crew could be under cover when the fire base came under attack from Viet Cong and North Vietnamese Army artillery projectiles, rockets and mortar fire. Wherever possible the fire bases were located where they could also support another fire base. This proved very useful, as often a particular fire base could not engage the forces attacking it with artillery. The smaller-calibre 105-mm (4.13-in) and 155-mm (6.1) howitzers were always provided with the deadly beehive rounds for use against mass infantry attacks, and these were used on numerous occasions in Vietnam. In many cases these stopped the bases from being overrun: the 105-mm (4.13-in) M546 projectile contained no fewer than 8,000 needle-like flechettes, quite devastating in the anti-personnel role.



There was no anti-personnel round for the 203-mm (8-in) M110, but a standard high explosive projectile was fitted with a mechanical time fuze set to burst about 9.14 m (30 ft) above the ground at ranges of 200 to 1000 m (220 to 1,095 yards). This was known as the Killer Senior, while the same technique with the 105-mm (4.13-in) or 155-mm (6.1-in) projectiles was called Killer Junior. The technique was often

Above: The M110A2, seen here in a camouflaged position, is the heaviest cannon artillery currently available to the US Army in Europe. It is capable of firing both nuclear and conventional ammunition.

Right: An early short-barrel 203-mm (8-in) M110 self-propelled howitzer in US Army service. The gun could only fire to 16800 m (55,118 ft) and is being replaced by the long-barrelled M110A2.

said to be more effective than the beehive projectile, whose effects the enemy could avoid by lying flat on the ground.

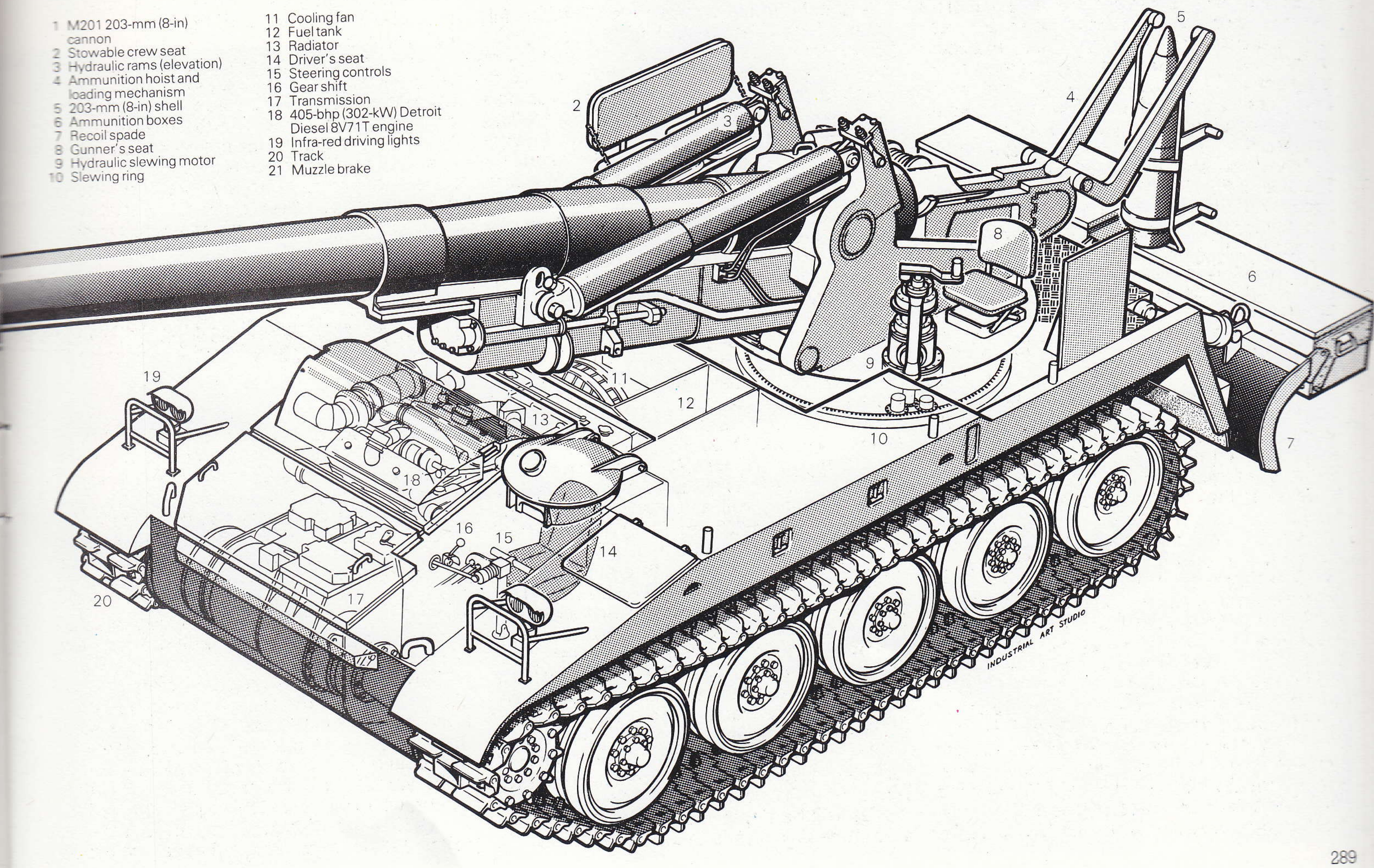
Ammunition resupply was a major problem as many of the firebases could be supplied only by helicopter. So ammunition had to be stockpiled in case fresh supplies could not be brought up as a result of bad weather, enemy action or the helicopters being earmarked for more important missions. When deployed in the static fire role each 203-mm (8-in) battery had a total of 800 projectiles and charges, with Improved Conventional Munitions also supplied in small numbers.

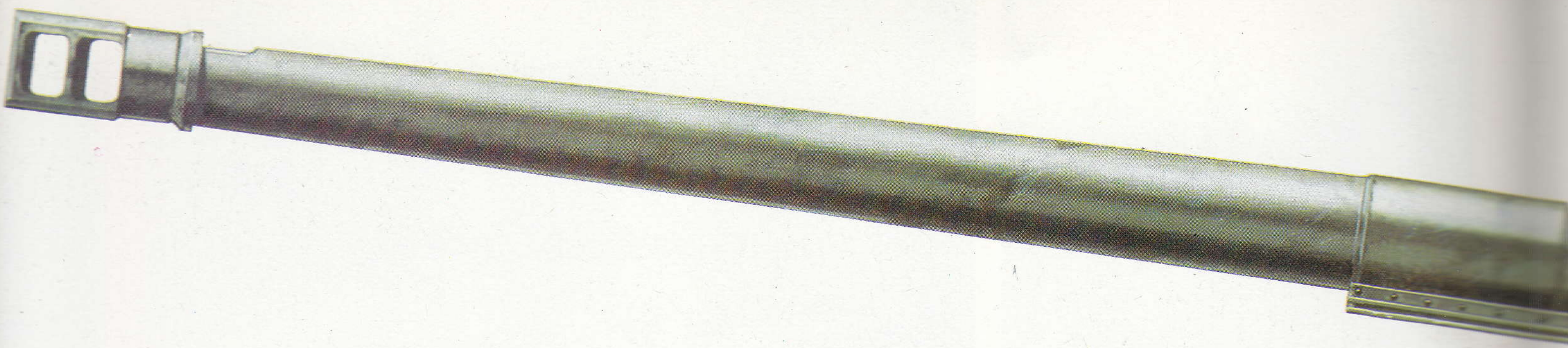
The towed weapons were very often redeployed to new fire positions by the Boeing Vertol CH-47 Chinook helicopter, but all of the self-propelled weapons had to be moved under their own power. In the early part of the war the main role of the artillery was to engage known and suspected Viet Cong targets, but on many occasions, especially towards the end of the war, Viet Cong and North Vietnamese artillery was also engaged, the Soviet-supplied 130-mm (5.12-in) M-46 proving a difficult weapon to neutralize as it outranged almost all of the artillery used in Vietnam with the exception of the M107. During offensive operations massive air strikes by Boeing B-52s were used to provide suppressive fire before a helicopter landing was made in an area saturated by artillery fire. For example, before H-hour each 105-mm (4.13-in) battery fired 1,000 rounds, each 155-mm (6.1-in) battery 600 rounds and each 175-mm (6.89-in) battery 200 rounds onto the landing zone.

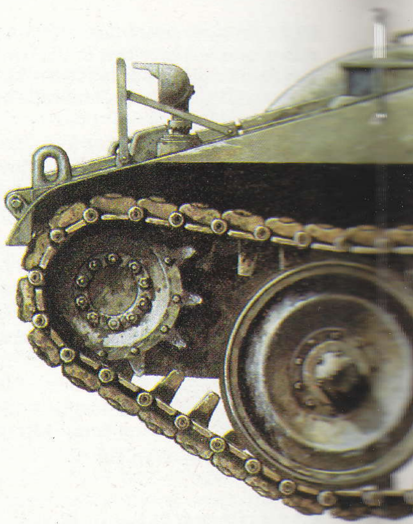
Fire control was a major problem and (in addition to helicopters, aircraft and forward observation officers) sensors, surveillance radars and AN/MPQ-4 locating radars were used. The last did not prove very successful, and as a result new systems were developed

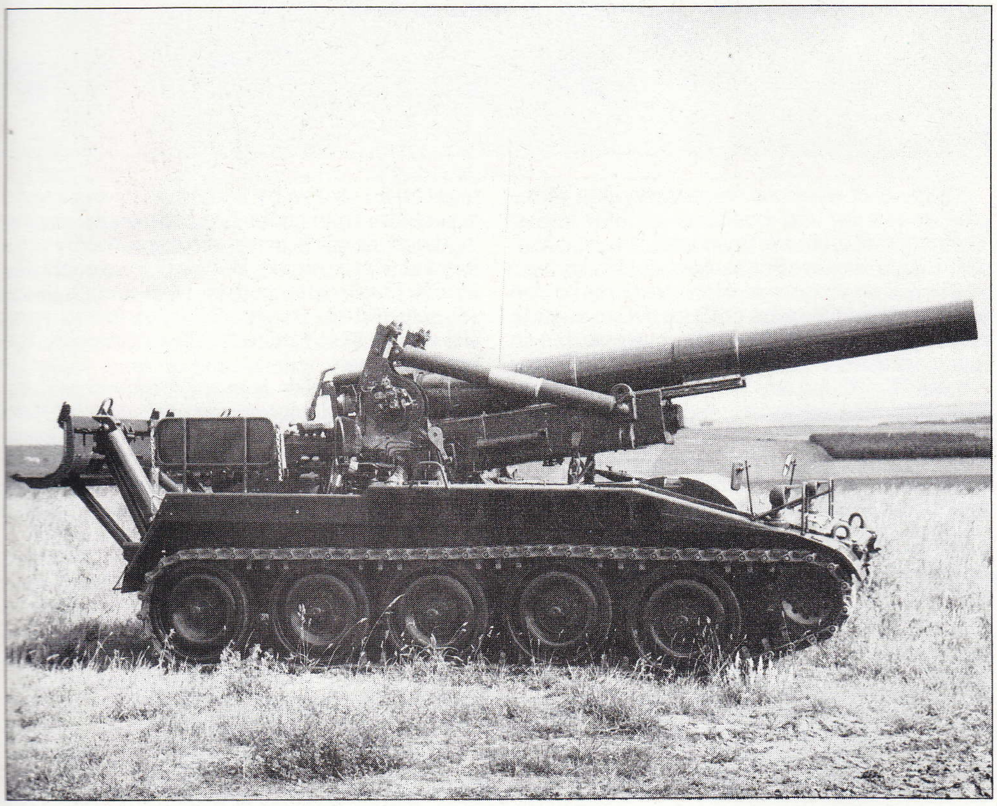
M110A2 SP howitzer cutaway drawing key

1 M201 203-mm (8-in) cannon
2 Stowable crew seat
3 Hydraulic rams (elevation)
4 Ammunition hoist and loading mechanism
5 203-mm (8-in) shell
6 Ammunition boxes
7 Recoil spade
8 Gunner's seat
9 Hydraulic slewing motor
10 Slewing ring
11 Cooling fan
12 Fuel tank
13 Radiator
14 Driver's seat
15 Steering controls
16 Gear shift
17 Transmission
18 405-bhp (302-kW) Detroit Diesel 8V71T engine
19 Infra-red driving lights
20 Track
21 Muzzle brake

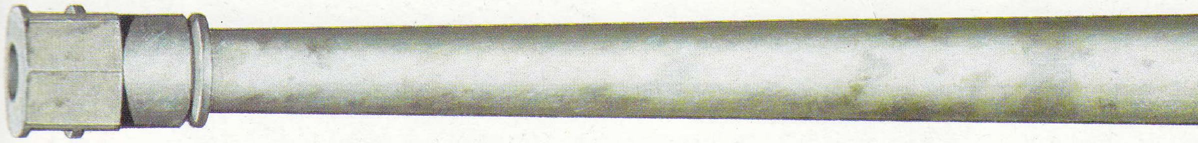


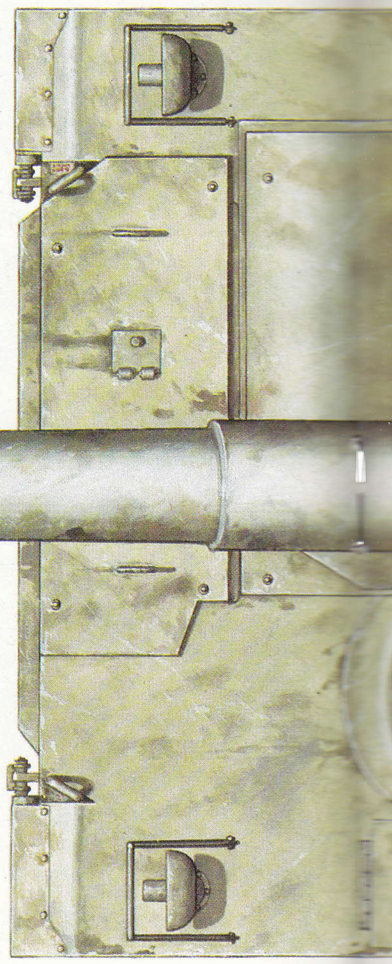






The original Model M110 has been superseded in US Army service by more capable developments, but remains in the front line with several armies, including the British army. Introduced in 1962, the M110 was essentially a self-propelled counterpart to the World War II-vintage M115 towed howitzer.

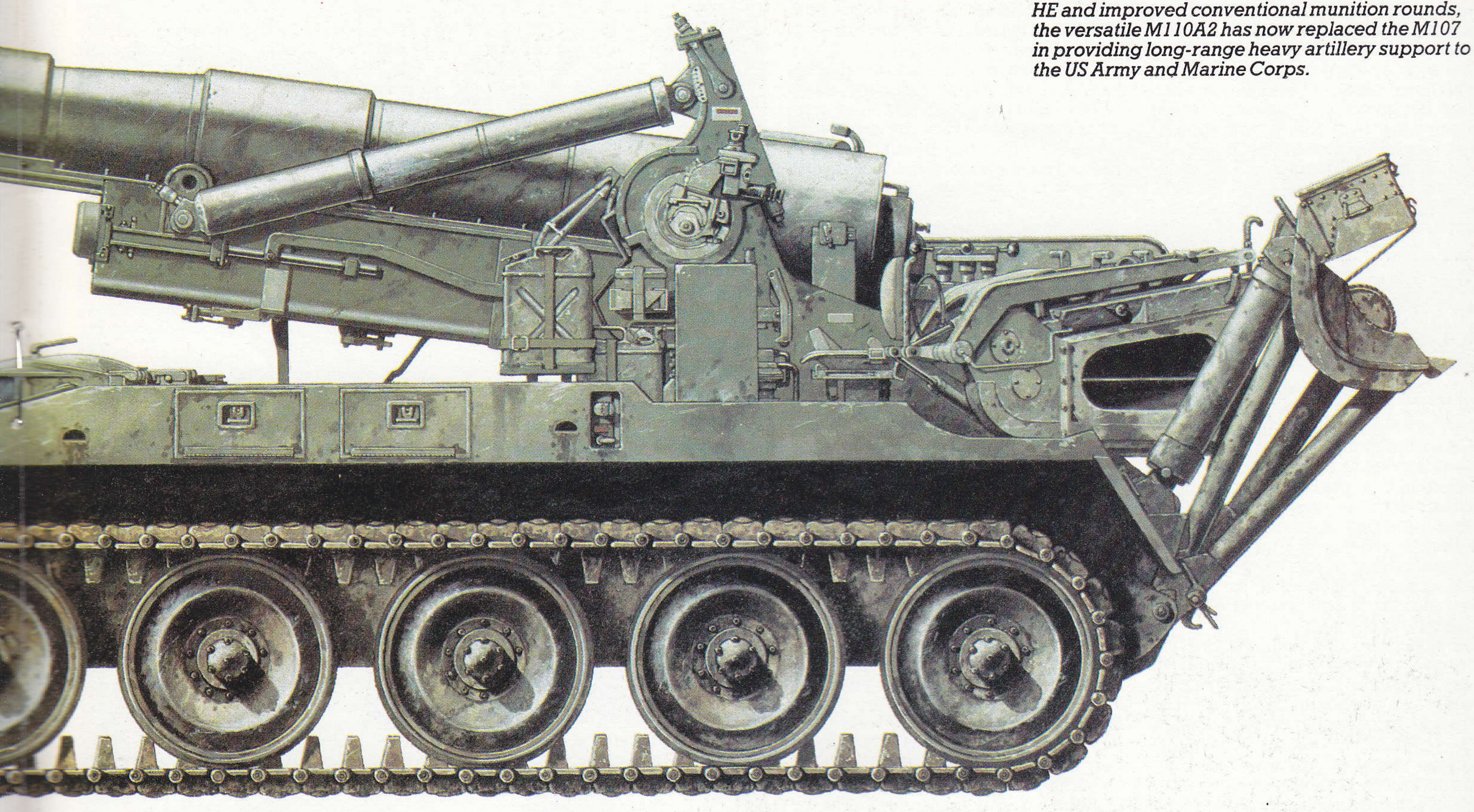


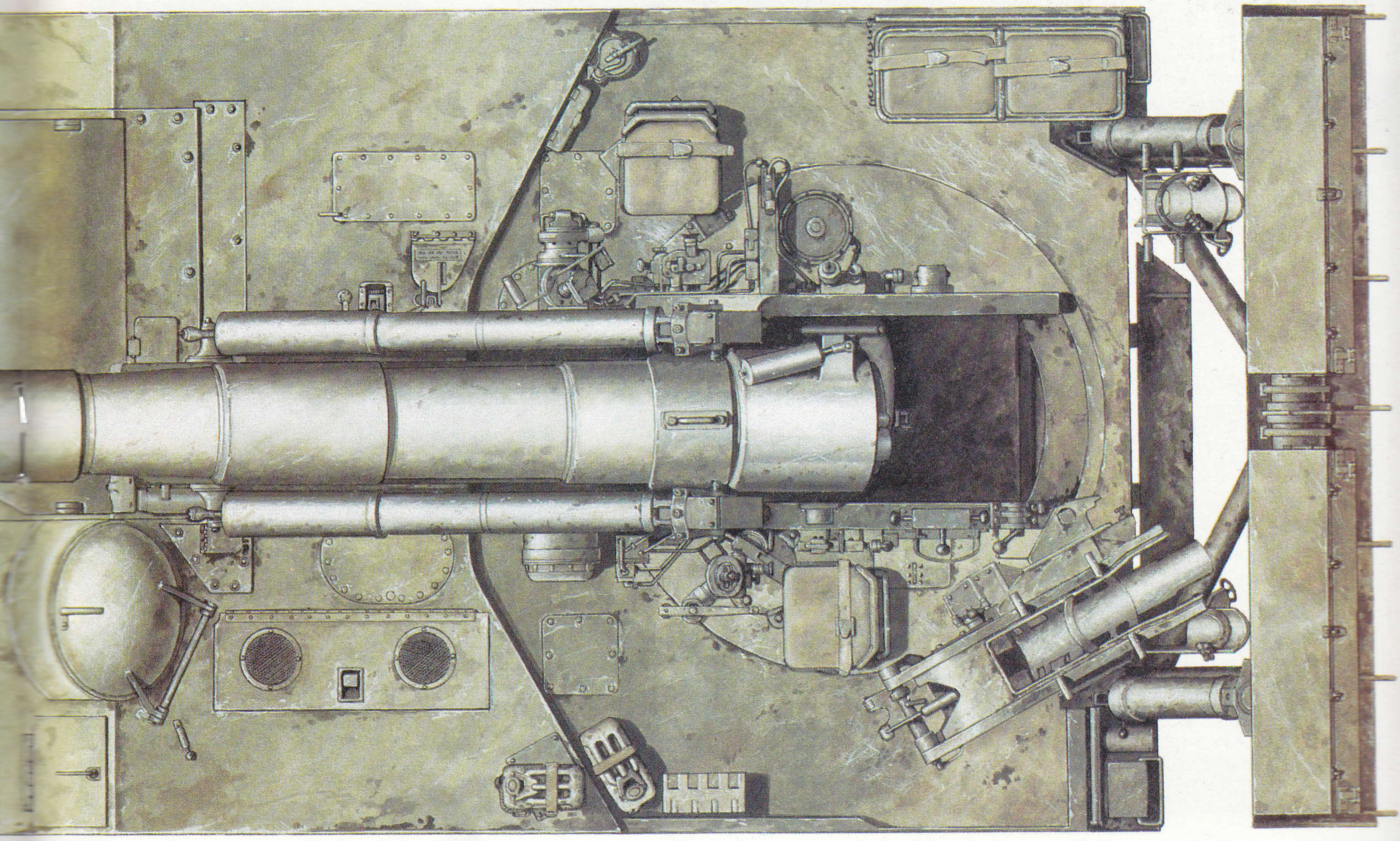


and have entered service with the US Army more recently.

At the peak there were just over 60 American artillery battalions in South Vietnam, the majority of them equipped with 105-mm (4.13-in) or 155-mm (6.1-in) towed howitzers. The artillery was more normally organized in Groups: for example, the 52nd Artillery Group, part of the artillery allocated to the First Field Force Artillery, consisted of four battalions of artillery, one with 105-mm (4.13-in) towed M108s, one with 155-mm (6.1-in) towed M114s, and two with a mix of 203-mm (8-in) and 175-mm (6.89-in) self-propelled guns. In July 1969 there were nine battalions with the M110 and M107. The M107 was also issued to two battalions of the South Vietnamese army, but these suffered heavy losses during the Viet Cong and North Vietnamese offensive of April 1972. Following the collapse of the South Vietnamese forces, it is known that the Vietnamese took over some of the M107s and M110s, and these may well have been used during the Vietnamese invasion of Kampuchea in the 1970s.

Designed to fire a wide range of nuclear, chemical, HE and improved conventional munition rounds, the versatile M110A2 has now replaced the M107 in providing long-range heavy artillery support to the US Army and Marine Corps.





Israeli Self-Propelled Artillery

In the 1950s the Israelis used a wide range of towed artillery weapons to provide fire support for their mechanized units, but it was soon realized that such artillery could not keep up with these highly mobile forces when they deployed to the desert, where roads were nonexistent. Israel therefore purchased quantities of the American World War II **Priest** 105-mm (4.13-in) and French 105-mm (4.13-in) **Mk 61** self-propelled howitzers despite the fact that they felt, as did most members of NATO at that time, that the 155-mm (6.1-in) projectile was much more effective than the 105-mm (4.13-in) shell because of the former's greater content of high explosive.

The first self-propelled weapon of 155-mm (6.1-in) calibre to enter service with the Israeli army was the **M-50**, which was developed in France by the Etablissement d'Etudes et Fabrications d'Armement de Bourges and entered service in 1963. This system was essentially a rebuilt Sherman tank chassis with the engine moved forward to the right of the driver to enable a French 155-mm (6.1-in) Modèle 50 howitzer (which in its towed configuration was used by Israel at that time) to be mounted in an open-topped compartment at the rear of the hull. When the vehicle is deployed in action, the two doors open to each side of the hull rear revealing horizontal ammunition racks and a tailgate folded down to provide space for the crew to operate the howitzer. Additional ammunition storage space is provided under the mount, and external stowage compartments are provided in each side of the hull. The 155-mm (6.1-in) howitzer fires an HE projectile weighing 43 kg (95 lb) to a maximum range of 17600 m (19,250 yards). Maximum elevation of the howitzer is +69° but traverse is very limited. The M-50 has a crew of eight men and weighs 31000 kg (68,340 lb) fully loaded. The main drawback of the system, which was used for the first time in the 1967 Middle East War, is the lack of any overhead protection for the crew from shell splinters and small arms fire.

The M-50 was followed in Israeli service by the **L-33** (named after the length of the ordnance in calibres) which was developed in Israel by Soltam and this saw action for the first time in the 1973 Middle East War. This is based on the M4A3E8 Sherman chassis, which has Horizontal Volute Spring Suspension (HVSS) rather than the Vertical Volute Spring Suspension (VSS) of the M-50, and gives a much improved ride across country. The original petrol engine has been replaced by a Cummins diesel for a much increased operational range.

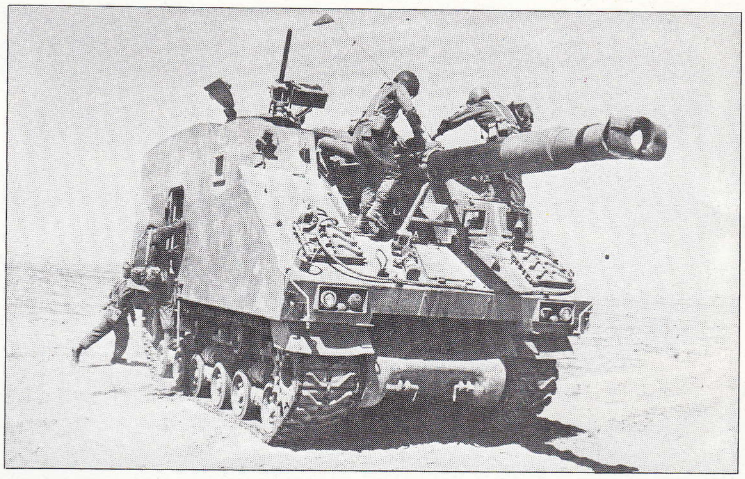
The 155-mm (6.1-in) M-68 gun/howitzer is almost identical to the standard towed weapon and is mounted in the forward part of the superstructure with an elevation of +52°, a depression of −3° and a traverse of 30° left and right. Weapon elevation and traverse are manual. The ordnance has a single-baffle muzzle brake, fume extractor, gun travel lock and a horizontal sliding semi-automatic breech block.

To assist in maintaining a high rate of fire and in loading the ordnance at any angle of elevation, a pneumatic rammer is installed. The weapon fires an HE projectile weighing 43 kg (95 lb) to a maximum range of 21000 (22,965 yards) at maximum charge; smoke and illuminating projectiles can also be fired. A total of 60 projectiles and charges is carried, 16 of which are for ready use. A 7.62-mm (0.3-in) machine-gun is mounted on the roof for local and anti-aircraft defence.

The hull is of all-welded steel construction and provides the crew with complete protection from small arms fire and shell splinters. Entry doors are provided on each side of the hull, and ammunition resupply doors are fitted in the hull rear; ammunition can be loaded via these doors when the weapon is still firing. The driver is seated at the front on the left with the commander to his rear; the anti-aircraft machine-gunner is in a similar position on the opposite side, and each of these crew members is provided with a roof hatch and bulletproof windows to their front and side for observation.

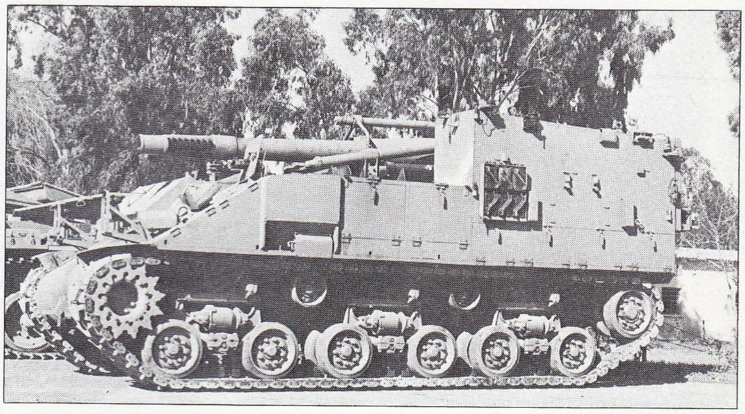
Unlike the earlier M-50 conversion, which entailed moving the engine forward, the L-33 has its engine at the rear, power being transmitted to the transmission at the front of the hull by a two-part propeller shaft.

As a private venture Soltam has also developed the 155-mm (6.1-in) self-propelled howitzer M72. This is a turret that weighs 14000 kg (30,865 lb) complete with ammunition and can be fitted onto a variety of tank chassis including the M60 and M48. The prototype has already been fitted onto a Centurion tank chassis for trials purposes. The prototype has a 33-calibre barrel but a 39-calibre barrel can be fitted, this allowing a 43-kg (95-lb) projectile to be fired to a range of 23500 m (25,700 yards). So far this turret system has not been adopted by the Israeli army as it already has some 200 American supplied M109A1 and M109A2 self-propelled artillery weapons in service.



Above: The crew of a 155-mm (6.1-in) L-33 man their vehicle during an exercise. The L-33 was first extensively used in combat during the 1973 war.

Below: Oldest of the self-propelled guns in Israeli service is the 155-mm (6.1-in) M-50. This entered service in 1963 and is still in service today with reserve units.



Specification

Soltam L-33 155-mm Self-Propelled Gun/Howitzer

Crew: 8

Weight: 41500 kg (91,490 lb)

Dimensions: length (gun forward) 8.47 m (27 ft 9½ in); length (hull) 6.47 m (21 ft 2¾ in); width 3.50 m (11 ft 6 in); height 3.45 m (11 ft 3¾ in)

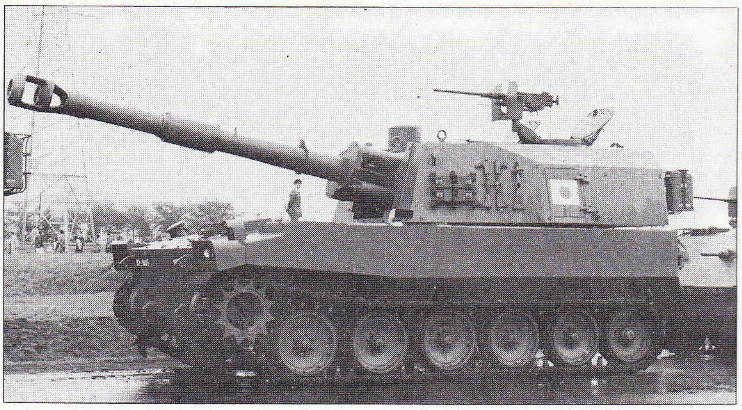
Powerplant: one Cummins diesel developing 460 hp (343 kW)

Performance: maximum road speed 36.8 km/h (23 mph); maximum range 260 km (162 miles); gradient 60%; vertical obstacle 0.91 m (3 ft); trench 2.30 m (7 ft 6½ in)

Below: The Israeli Army is the only Western nation to use 160-mm (6.3-in) self-propelled mortars. The high angle of fire proved extremely useful in the mountain fighting against Syrian troops during the 1982 invasion of Lebanon.

JAPAN

Type 75 155-mm Self-Propelled Howitzer



When the Japanese Ground Self-Defense force was formed in the 1950s all its artillery was of towed types and supplied by the United States. With increased mechanization taking place in the 1960s, the United States also supplied 30 105-mm (4.13-in) M52 and 10 155-mm (6.1-in) M44 self-propelled howitzers. In the later 1960s development of indigenous 105-mm (4.13-in) and 155-mm (6.1-in) self-propelled howitzers started in Japan, the former eventually being standardized as the Type 74 and the latter as the **Type 75.** Only 20 of the Type 74 were built as a decision was taken to concentrate on the more effective 155-mm (6.1-in) system.

So far about 50 Type 75s have been built, with Mitsubishi Heavy Industries responsible for the hull and final assembly, and Japan Iron Works/Nihon Seiko for the gun and turret. The Japanese Ground Self-Defense Force expects to have 200 Type 75s in service by the late 1980s.

In many respects the Type 75 is similar to the American M109, with the engine and transmission at the front and the fully enclosed turret at the rear. The six-man crew consists of the commander, layer, two loaders and radio operator in the turret, and the driver at the front. The hull and turret are of all-welded aluminium construction, which provides the crew with complete protection from small arms fire and shell splinters. The suspension is of the torsion-bar type, and consists of six road wheels on each side, the rearmost serving the idler; the drive sprocket is at the front, and there are no return rollers.

The 30-calibre barrel has an interrupted screw type breech block, a fume extractor and a double-baffle muzzle-brake. When the Type 75 is travelling the barrel is normally held in a travel lock mounted on the glacis plate. The ordnance has an elevation of +65° and a depression of −5°, and the turret can traverse 360°. Weapon elevation and turret traverse are hydraulic, with manual controls provided for emergency use. Before fire is opened, two spades are manually lowered to the ground at the rear of the hull to provide a more stable firing platform.

The Type 75 can fire 18 rounds in three minutes, such a rate being achieved by the use of two drum-type magazines (one on each side of the turret and containing nine projectiles each, a two-part extending loading tray and an hydraulic rammer. Once the gun has fired, it automatically returns to an angle of +6° for reloading. The breech is opened, the extending loading tray positioned, the projectile is then charge loaded with the aid of the hydraulic rammer, the breech closed, the loading tray returned to normal position and the weapon fired again. The drum magazines are rotated electrically or manually and can be reloaded from outside the vehicle via two doors/hatches in the turret rear. In action the Type 75 would probably fire 12 or 18 rounds before moving off to a new fire position before the enemy could return fire. In addition to the 18 projectiles in the two magazines, a further 10 projectiles are carried internally as are 56 fuzes and 28 bagged charges. Mounted externally at the commander's station is a standard 12.7-mm (0.5-in) M2HB machine-gun with a shield.

Standard equipment includes infrared night-vision lights, a fire extinguishing system, an NBC pack, a turret ventilator and a crew compartment heater. An amphibious kit was developed but not adopted, but the Type 75 can ford to a depth of 1.3 m (4 ft 3 in) without preparation.

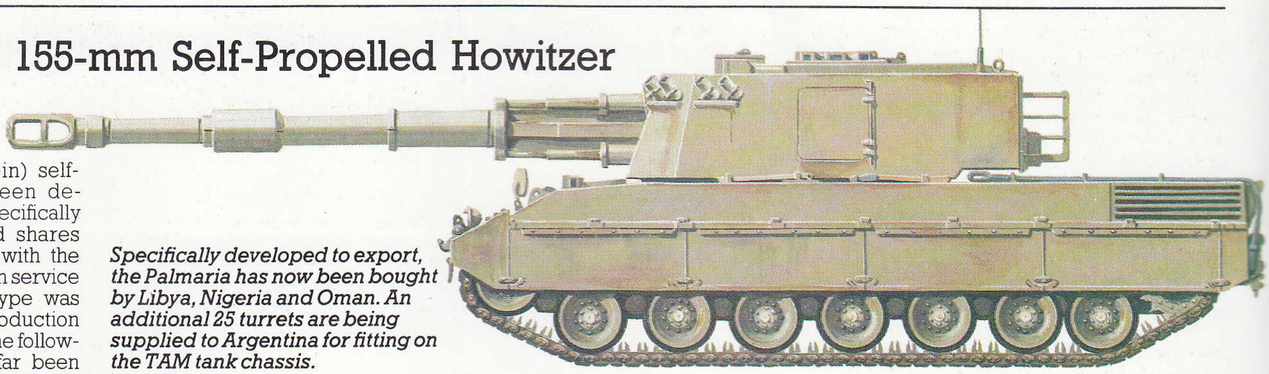
The Type 75 self-propelled howitzer is essentially a Japanese-designed and built counterpart to the American M109.

Specification

Crew: 6
Weight: 25300 kg (55,775 lb)
Dimensions: length (gun forward) 7.79 m (25 ft 6⅔ in); length (hull) 6.64 m (21 ft 9½ in); width 3.09 m (10 ft 1¾ in); height (without MG) 2.545 m (8 ft 4 in)
Powerplant: one Mitsubishi 6-cylinder diesel developing 450 hp (336 kW)
Performance: maximum road speed 47 km/h (29 mph); range 300 km (185 miles); gradient 60%; vertical obstacle 0.70 m (2 ft 3 in); trench 2.50 m (8 ft 2½ in)

ITALY

Palmaria 155-mm Self-Propelled Howitzer



Specifically developed to export, the Palmaria has now been bought by Libya, Nigeria and Oman. An additional 25 turrets are being supplied to Argentina for fitting on the TAM tank chassis.

The **Palmaria** 155-mm (6.1-in) self-propelled howitzer has been developed by OTO Melara specifically for the export market, and shares many common components with the OF-40 MBT which is already in service with Dubai. The first prototype was completed in 1981, and production vehicles were completed in the following year. The type has so far been ordered by Libya (200) and Nigeria (25), although the latter order has not yet been officially confirmed.

The layout of the Palmaria (named after an Italian island) is similar to that of a tank with the driver at the front of the hull, turret in the centre and the engine and transmission at the rear. The major difference beteen the chassis of the Palmaria and that of the OF-40 MBT is that the former has thinner armour and is powered by a V-8 diesel developing 750 hp (559 kW) whereas the OF-40 has a V-10 diesel developing 830 hp (619 kW).

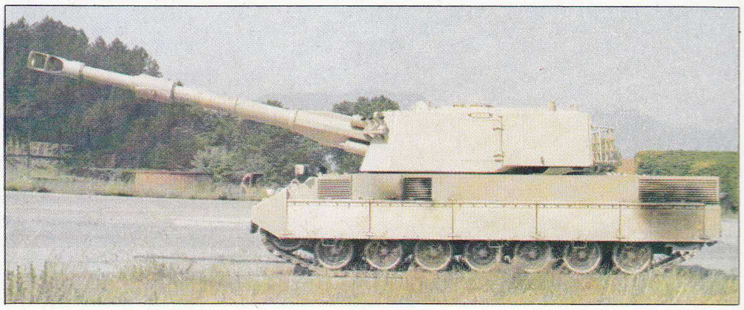
The 155-mm (6.1-in) 41-calibre barrel is fitted with a fume extractor and a multi-baffle muzzle-brake. The turret has 360° traverse and the ordnance can be elevated from −4° to +70° hydraulically, with manual controls for emergency use. An unusual feature of the Palmaria is the installation of an auxiliary power unit to provide power for the turret, thus conserving fuel for the main engine. The Palmaria is available with a normal manual loading system or a semi-automatic loading system. With the latter, a three-round burst can be fired in 30 seconds and then one round every 15 seconds can be maintained until the 23 ready-use projectiles have been fired; a further seven projectiles are stowed elsewhere in the hull. Once the ordnance has fired, it automatically returns to an elevation of +2°, the breech opens, the projectile is loaded with power assistance, the charge is loaded manually, the breech is closed and the ordnance can be fired again.

A complete range of ammunition has been developed for the Palmaria by Simmel: the range consists of four different rounds, each of which weighs 45.5 kg (100 lb). The high explosive, smoke and illuminating projectiles have a range of 24000 m (26,245 yards), and the rocket-assisted projectile has a range of 30000 m (32,800 yards). The extra range of the RAP has a penalty, however, inasmuch as it is achieved only at the expense of HE content, which is 8 kg (17.6 lb) compared with 11.7 kg (25.8 lb) in the normal projectile.

A 7.62-mm (0.3-in) machine-gun is mounted at the commander's station on the right side of the turret roof, and four electrically-operated smoke dischargers can be fitted to each side of the turret if required.

A wide range of optional equipment can be fitted, including passive night-vision equipment and an NBC system. Standard equipment on all vehicles includes a hull escape hatch, bilge pumps and an automatic fire-extinguishing system. Track skirts help to keep down dust when the vehicle is travelling across country.

One of the prototypes of the OTO Melara Palmaria, based on the chassis of the OF-40 MBT but fitted with a smaller diesel engine.



Specification

Crew: 5
Weight: 46000 kg (101,410 lb)
Dimensions: length (gun forward) 11.474 m (37 ft 7¾ in); length (hull) 7.40 m (24 ft 3⅓ in); width 2.35 m (7 ft 8½ in); height (without MG) 2.874 m (9 ft 5¼ in)
Powerplant: 8-cylinder diesel developing 750 hp (559 kW)
Performance: maximum road speed 60 km/h (37 mph); maximum range 400 km (250 miles); gradient 60%; vertical obstacle 1.00 m (3 ft 3 in); trench 3.00 m (9 ft 10 in)

Artillery in the British Army of the Rhine

Included in the British Army of the Rhine 1 (British) Corps to support its three Armoured Divisions is practically the whole of the UK's inventory of self-propelled artillery pieces. Although considered a large force by British standards, it is still outgunned by the missiles and artillery pieces available to a single Soviet tank or combined arms army.

Units of the Royal Artillery deployed to West Germany are nine Field Regiments (Abbots and M109A1s), one heavy regiment with M107s, one missile regiment with Lance surface-to-surface missiles fitted with a tactical nuclear warhead, two air-defence regiments with towed British Aerospace Rapier surface-to-air missiles and one locating regiment with EMI Electronics locating radars.

Under the revised structure of the British Army of the Rhine (BAOR), I (British) Corps in West Germany consists of the 1st, 3rd and 4th Armoured Divisions, the 2nd Infantry Division, one artillery division and the usual corps troops (including engineers, signals and Army Air Corps units).

The artillery division has one Missile Regiment of four batteries, each with three Lance missile-launchers and their associated resupply vehicles. All these are based on the FMC M548 tracked cargo-carrier chassis, the launcher being designated M752 and the resupply vehicle M668; the latter carries a hydraulic crane for lifting the missiles. The Lance missile has a maximum range of about 110 km (68 miles), and is widely used in NATO as well as by Israel. In time of war the Lance units would be some of the first to be attacked by Soviet special forces, and for this reason they are protected by infantry at all times. The artillery division has one heavy regiment, two air-defence regiments, one locating regiment and a weapon support group that includes an infantry battalion and a Royal Corps of Transport regiment for transport supplies.

The Heavy Regiment has an HQ battery, Royal Electrical and Mechanical Engineers workshop, Royal Army Ordnance Corps stores section and four batteries each with six 175-mm (6.89-in) M109 self-propelled guns. The M109s can fire only an HE projectile, weighing 67 kg (147.7 lb), to a maximum range of 32700 m (35,750 yards). The M107s are to be refitted with the new long-barrelled 203-mm (8-in) howitzer and will then be designated M110A2.

Each of the Air-Defence Regiments has an HQ battery, Royal Electrical and Mechanical Engineers workshop, Royal Army Ordnance Corps stores platoon and three batteries of British Aerospace towed Rapier surface-to-air missiles, whose efficiency was amply shown in the Falklands. Each battery has three troops each with four Rapier launchers towed by 1-tonne Land Rovers. Following the withdrawal of the Thunderbird SAM in the 1970s, Rapier is the longest-range anti-aircraft weapon in service with the Royal Artillery. Enemy aircraft flying at medium to high altitudes will have to be engaged by fighter aircraft or by the forces of other NATO countries equipped with Raytheon HAWK or Nike Hercules missiles. The basic Rapier is a clear-weather system, but when used in conjunction with the Marconi Space and Defence Systems Blindfire radar has an all-weather capability. The Royal Air Force Regiment deploys the Rapier/Blindfire to all RAF airfields in West Germany, but the Royal Artillery do not issue every Rapier launcher with a Blindfire radar as many of the Soviet aircraft and helicopters it expects to engage in time of war do not as yet have an all-weather capability. At present the British army is one of the few countries in NATO that does not have a self-propelled anti-aircraft gun system: Belgium, West Germany and the Netherlands, for example, all have the twin 35-mm Gepard, while the United States is now introducing the Sgt York DIVAD twin 40-mm system and the French army has the twin 30-mm system on an AMX-13 chassis.

Mobile SAM cover

In the near future Tracked Rapier will be introduced into service in the British Army of the Rhine with the reorganization of each air-defence regiment. The latter will have two batteries of towed Rapier and two batteries of Tracked Rapier with a total of 10 firing units per battery. Tracked Rapier will be supported by a Forward Area Support Team (FAST) vehicle which carries a relief crew, 20 reload missiles and ready-use stores. The introduction of Tracked Rapier will at last enable mechanized units in Germany to have mobile SAM protection.

The Locating Regiment is the eyes and ears of the artillery division, and has three Locating Batteries with the Cymbeline mortar-locating radar, a drone troop with the Canadian CL-89 reconnaissance RPV, a Meteorological Troop and a Sound Ranging Troop. The CL-89 is launched from the rear of a Bedford 4×4 4-tonne truck and flies a predetermined course over enemy lines, where its sensor package starts to operate. It then flies back to its predetermined recovery area where it is slowed by a drogue parachute until the main parachute opens. Airbags are then inflated to keep the drone from damage as it arrives on the ground. The sensor package includes a Carl Zeiss camera system and a Hawker Siddeley Dynamics infra-red Linescan system; once the drone is on the ground the sensor package is removed for analysis, and any target information obtained is relayed to the command centre so that the target can be engaged. The main drawback of this system, which is also used by Canada, West Germany and Italy, is the time taken to process the information, as by the time this is carried out the target may well have moved. For this reason future RPVs will have a real-time sensor package that transmits information (including TV pictures) back straight away, or will be fitted with a laser designator to enable targets to be engaged with Martin Marietta Copperhead Cannon-Launched Guided Projectiles (CLGPs) or Hellfire missiles.

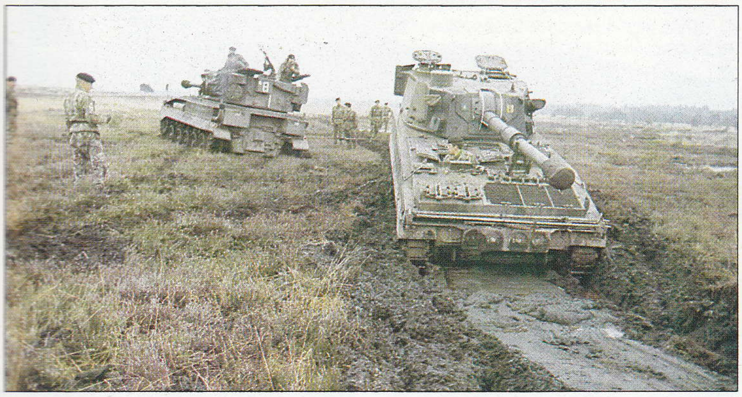
Above: Basic M109s of the 45th Medium regiment operating in West Germany during the mid-1970s.

Below right: The crew of a camouflaged 42nd Regiment M107 race their gun into action during an exercise.

The Meteorological Troop is equipped with the AMETS artillery meteorological system, which consists of a command post vehicle that also tows the generator, a Land-Rover reconnaissance vehicle that tows the radar trailer, an optical tracker, a stores vehicle, hydrogen trailers, a balloon-filling shelter and the balloons themselves. The troop's activities are basically simple: a small balloon is sent aloft, and attached to this are a radar reflector and the radio sonde transmitter; the balloon is automatically tracked by the Plessey WF3M radar while the radio sonde transmits a signal giving the temperature back to the ground; the signal is passed through a special converter that transforms the received signals into a form suitable for input into the computer; information from the tracking radar is then fed into the computer; and pressure is calculated by the computer from the surface pressure and radar height using standard ICAO atmosphere figures corrected for temperature. The computer can provide eight types of meteorological message that can be fed directly into the Field Artillery Computer Equipment deployed at battery level throughout the Royal artillery. The eight types of message are standard computer message, standard ballistic message, surveillance drone message, sound ranging message, weapon locating radar message, biological/chemical message, nuclear fallout message and a civil forecasting message.

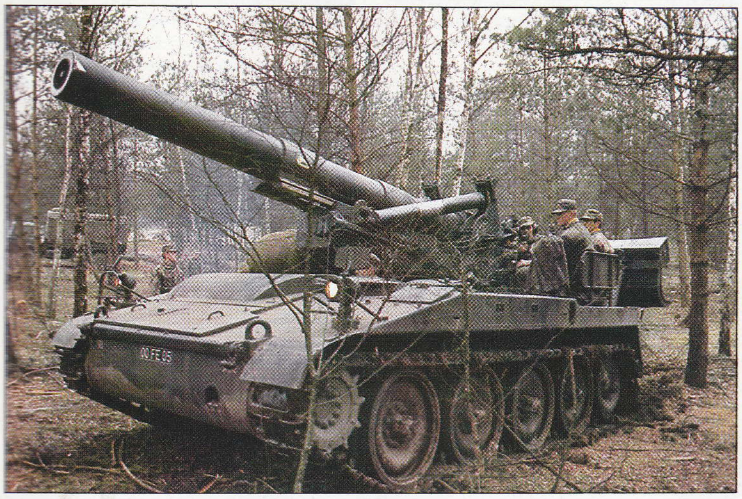
The Sound Ranging Troop is equipped with the Plessey No. 2 Mk 1 sound ranging link, which is normally carried in modified FV432 APCs, which are also used to carry the FACE in the battery command role.

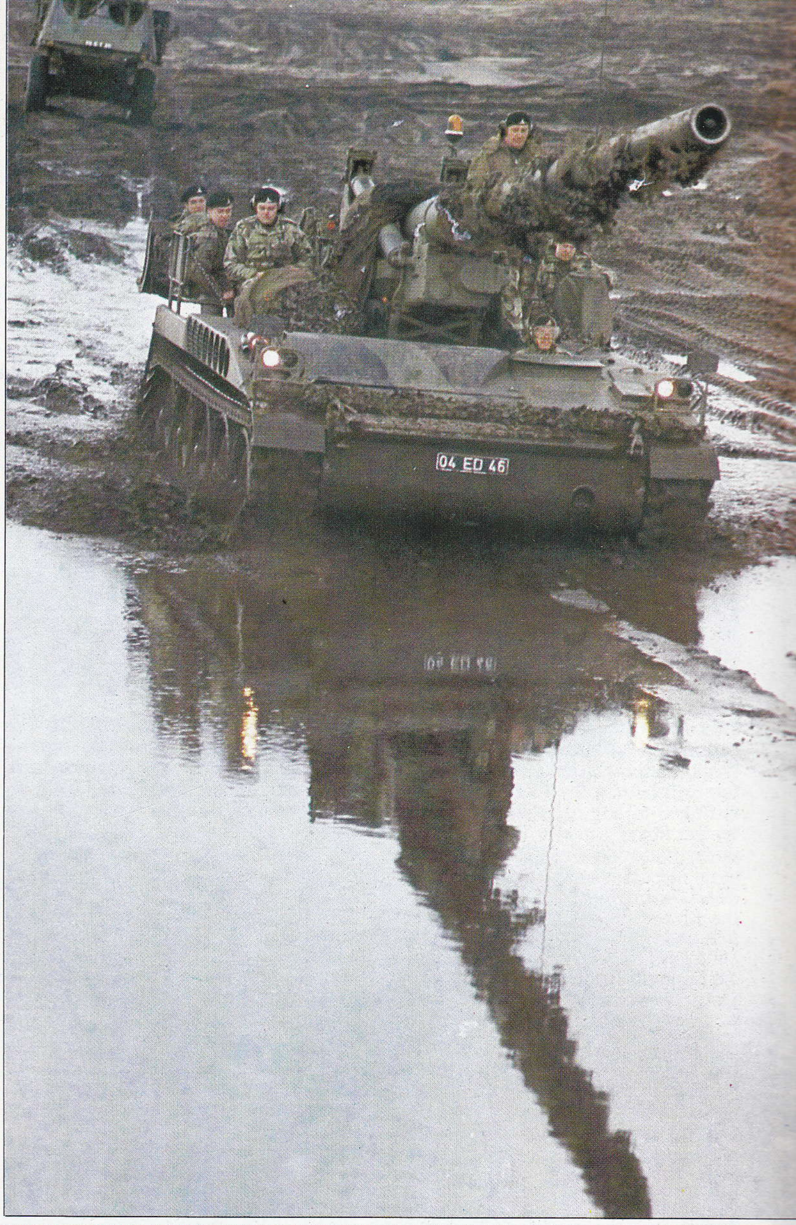
Each of the four divisions has an artillery group that until recently contained an anti-tank battery equipped with Striker or FV438 AGTW carrier vehicles. But these have now been returned by the Royal Artillery to the Royal Armoured Corps. The artillery group has two field regiments. One of these has four field batteries each with six 105-mm (4.13-in) Abbot self-propelled guns and an HQ battery that also controls the mortar-locating group with four Cymbelines. The other field regiment has the HQ battery, two field batteries with six 155-mm (6.1-in) M109A1/M109A2 self-propelled howitzers, a heavy battery with 203-mm (8-in) M110A2s and an air-defence battery. The last consists of a battery HQ and two troops each of three sections of four Alvis Spartan APCs that carry teams armed with the Blowpipe SAM system.



Above: The versatility of the Abbot is demonstrated here as one vehicle pulls another out of a patch of marshy ground.

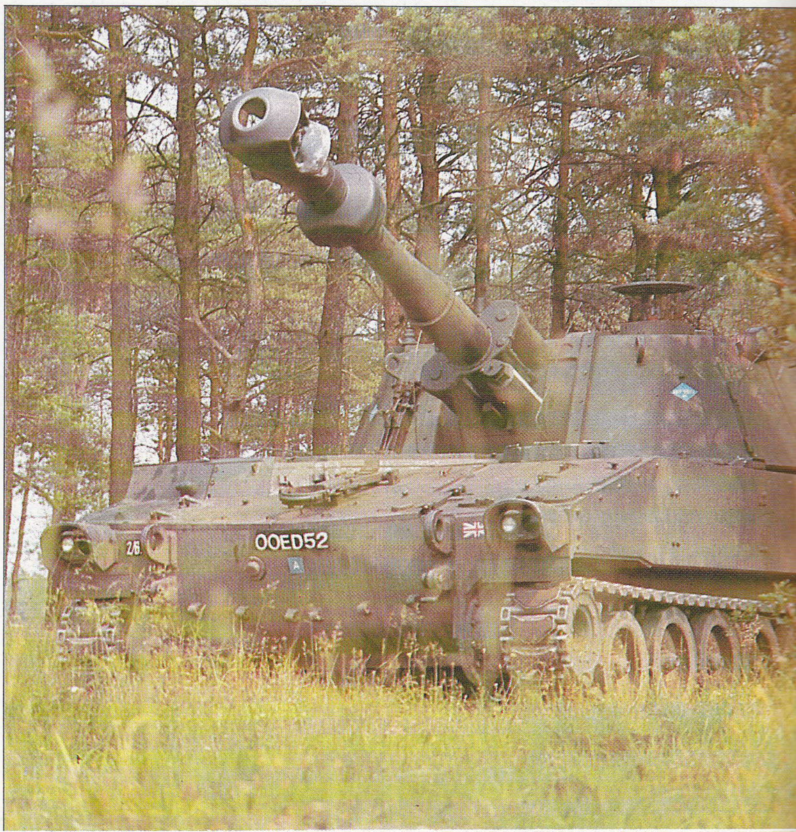
Below: Firing the heaviest HE shells and providing nuclear tube artillery support, the British Army uses the M110 self-propelled howitzer in its heavy batteries.





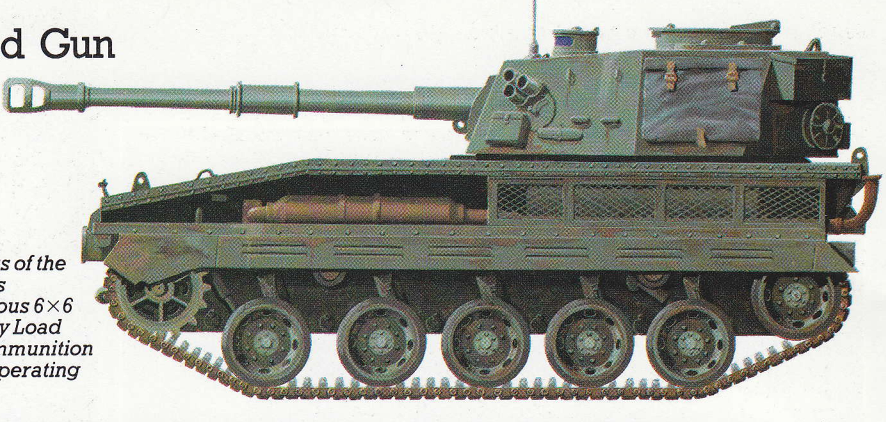
Above: The heavyweight 'sniper' of the British Army, an M107 of the 42nd Heavy Artillery Regiment (now disbanded).

Below: The American-built 155-mm M109 howitzer is the mainstay of the BAOR artillery units.



UK

Abbot 105-mm Self-Propelled Gun



Used in the Field Regiments of the Royal Artillery, the Abbot is supported by the amphibious 6×6 Alvis Stalwart High Mobility Load Carrier with prepacked ammunition pallets, and is capable of operating in an NBC environment.

After the end of World War II the standard self-propelled gun of the British Royal Artillery was the 25-pounder Sexton, which was designed and built in Canada. Prototypes of various self-propelled guns were built on a modified Centurion tank chassis, including one with a 25-pounder gun and the other with a 140-mm (5.5-in) gun. By the 1950s these calibres were not standard within NATO, which was standardizing on 105-mm (4.13-in) and 155-mm (6.1-in) rounds. To meet the Royal Artillery's immediate requirements for SP weapons of the latter calibre, quantities of American M44 self-propelled howitzers were supplied while development concentrated in England on the 105-mm (4.13-in) self-propelled gun which used the engine, transmission and suspension of the FV432 series of APC. Vickers of Elswick was awarded a contract to build 12 prototypes, of which six were powered by a petrol engine and six by a diesel engine. Following trials with these prototypes the company was awarded a production contract, series vehicles being built between 1964 and 1967. In the British army the **FV433 Abbot** 105-mm (4.13-in) self-propelled gun is used by the Royal Artillery in regiments of three batteries, each battery having eight Abbots. The Abbot is deployed in West Germany with the British Army of the Rhine, while a few serve with the Royal School of Artillery at Larkhill, Wiltshire, and at the British Army Training Area in Suffield, Canada. The **Value Engineered Abbot**, which is the basic vehicle without such luxuries as flotation screen, powered traverse, NBC system and night-vision equipment, was produced for India although the British army also has a few.

The hull and turret of the Abbot are of all-welded steel which provides the four-man crew with complete protection from small arms fire and shell splinters. The driver is seated at the front on the left, with the engine to his right. The turret is mounted at the very rear of the hull, with the commander and gunner on the right and the loader on the left. In addition to the commander's cupola and loader's roof hatches a large door is provided in the hull rear which is also used for ammunition supply. The Abbot is fitted with an NBC system, infra-red driving lights and, when originally introduced into the British army, with a flotation screen; the last has now been removed.

Main armament consists of a 105-mm (4.13-in) gun manufactured by the Royal Ordnance Factory Nottingham, a 7.62-mm (0.3-in) Bren light machine-gun at the commander's station for use in the anti-aircraft role, and one bank of three electrically-operated smoke dischargers on each side of the turret. The 105-mm (4.13-in) gun has a double-baffle muzzle-brake, a fume-extractor and a semi-automatic breech. Traverse is powered through 360°, while elevation is manual from −5° to +70°. The gun has a maximum range of 17000 m (18,600 yards) and fires the following types of separate-loading ammunition: HE, HESH, SH/PRACT, smoke (three types) and illuminating. A total of 40 projectiles is carried.

The ammunition of the Abbot is also used in the Royal Ordnance Factory Nottingham 105-mm (4.13-in) Light Gun, whose ordnance has been developed from the L13A1 gun of the Abbot.

Replacement of the Abbot by the 155-mm (6.1-in) M109A2 has started recently, but it is expected that the Abbot will not be retired from the Royal Artillery until the late 1980s, when the 155-mm (6.1-in) SP-70 is introduced.

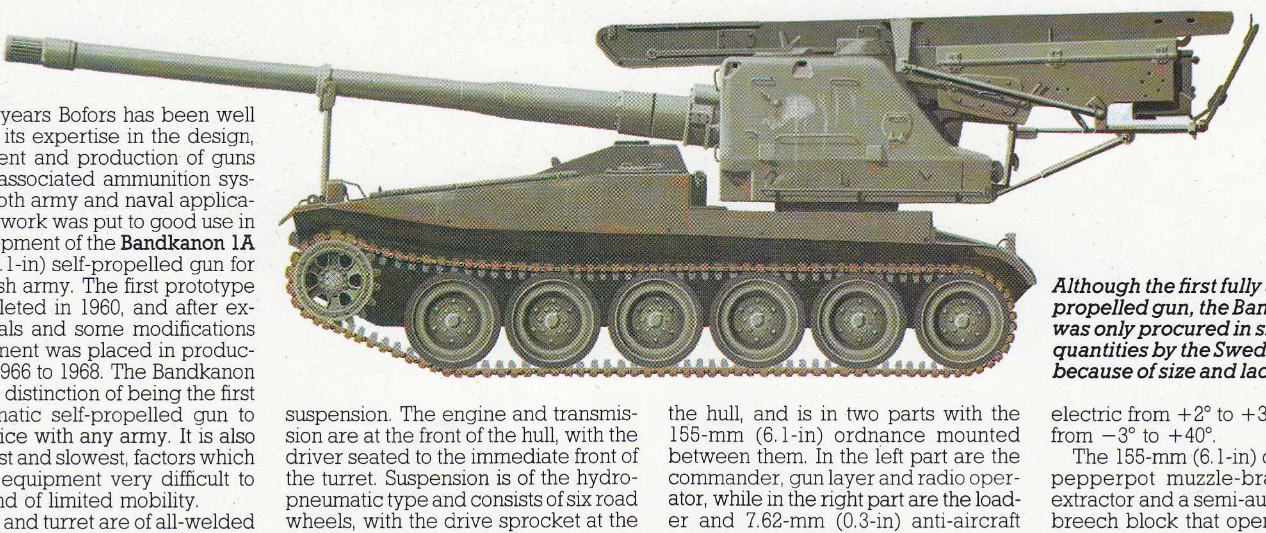
Specification

Crew: 4
Weight: 16556 kg (36,500 lb)
Dimensions: length (gun forward) 5.84 m (19 ft 2 in); length (hull) 5.709 m (18 ft 8¾ in); width 2.641 m (8 ft 8 in); height (without armament) 2.489 m (8 ft 2 in)
Powerplant: one Rolls-Royce 6-cylinder diesel developing 240 hp (179 kW)
Performance: maximum road speed 47.5 km/h (30 mph); maximum range 390 km (240 miles); gradient 60%; vertical obstacle 0.609 m (2 ft 0 in); trench 2.057 m (6 ft 9 in)

Eventually to be replaced in the late 1980s by the SP-70 155-mm (6.1-in) gun, the Abbot is no longer fitted with a flotation screen.

SWEDEN

Bandkanon 1A 155-mm Self-Propelled Gun



Although the first fully automatic self-propelled gun, the Bandkanon 1A was only procured in small quantities by the Swedish army because of size and lack of mobility.

For many years Bofors has been well known for its expertise in the design, development and production of guns and their associated ammunition systems for both army and naval applications. This work was put to good use in the development of the **Bandkanon 1A** 155-mm (6.1-in) self-propelled gun for the Swedish army. The first prototype was completed in 1960, and after extensive trials and some modifications the equipment was placed in production from 1966 to 1968. The Bandkanon 1A has the distinction of being the first fully automatic self-propelled gun to enter service with any army. It is also the heaviest and slowest, factors which make the equipment very difficult to conceal and of limited mobility.

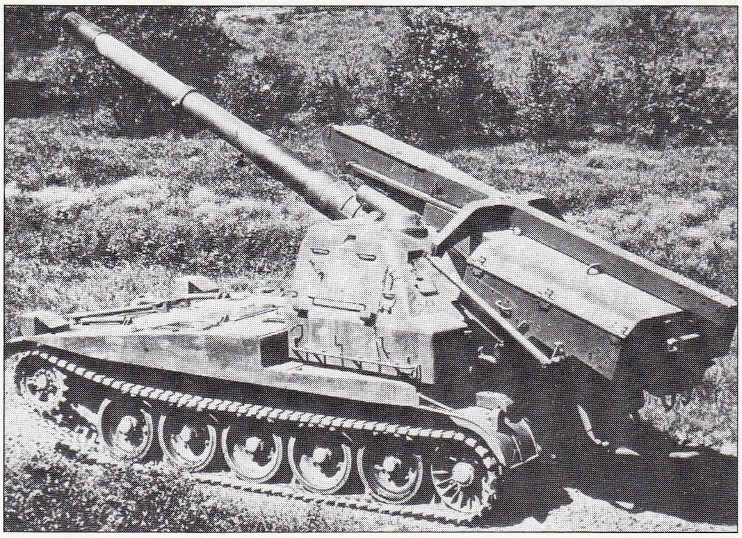
The hull and turret are of all-welded steel construction that varies from 10 mm (0.4 in) to 20 mm (0.8 in) in thickness. The vehicle uses many automotive components of the Bofors S-tank, including the powerpack and suspension. The engine and transmission are at the front of the hull, with the driver seated to the immediate front of the turret. Suspension is of the hydro-pneumatic type and consists of six road wheels, with the drive sprocket at the front and the last road wheel acting as the idler. To provide a more stable firing platform the suspension can be locked.

The turret is mounted at the rear of the hull, and is in two parts with the 155-mm (6.1-in) ordnance mounted between them. In the left part are the commander, gun layer and radio operator, while in the right part are the loader and 7.62-mm (0.3-in) anti-aircraft machine gunner. Turret traverse is manual, 15° left and right when the ordnance is above 0° in elevation, reducing to 15° left and 4° right when the ordnance is below 0°. Elevation is electric from +2° to +38°, and manual from −3° to +40°.

The 155-mm (6.1-in) ordnance has a pepperpot muzzle-brake, no fume-extractor and a semi-automatic wedge breech block that opens downwards. An unusual feature of the ordnance is that it has a replacable liner. When travelling, the ordnance is held in position by a lock pivoted at the front of the hull.

The ammunition is fed from a 14-round clip carried externally in an armoured magazine at the rear of the hull. This clip consists of seven compartments, each of which contain two rounds of ammunition, these being fed to the breech by a loading tray before being rammed into the breech by a rammer. The loading tray and rammer are operated by springs that are cocked by the run-out of the gun. The first round has to be manually loaded but after this the sequence is fully automatic and the gunner can select single shots or fully automatic. The empty cartridge cases are ejected from the breech to the rear. Once the clip of ammunition has been expended a fresh clip is brought up by truck, the ordnance is elevated to +38°, covers on the magazine are opened vertically, a hoist on the upper part of the turret slides along the slide bar before picking up the clip and placing it in the magazine, the doors are then closed and the hoist is returned to travelling position. Fire can then be resumed. This whole sequence takes just two minutes.

The 155-mm (6.1-in) projectile has a range of 25600 (28,000 yards). For some time it has been reported that a rocket-assisted projectile is under development that will have a range of about 30000 m (32,800 yards).



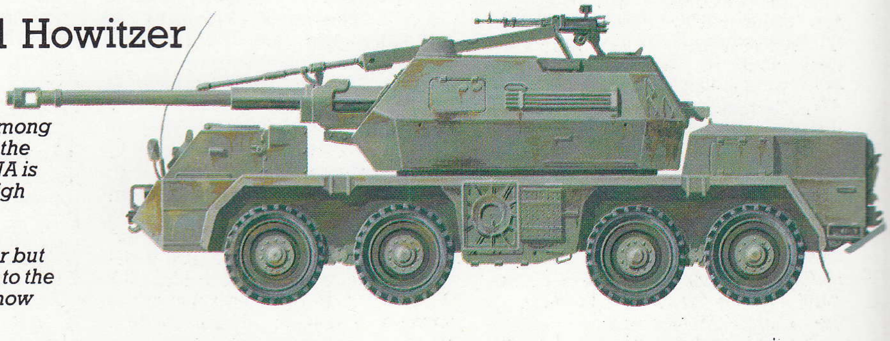
The Bandkanon 1A prepares to fire. The unique 14-round armoured magazine is at the rear of the hull; once expended it can be reloaded in less than two minutes from a resupply truck.

Specification

Crew: 5
Weight: 53000 kg (116,845 lb)
Dimensions: length (gun forward) 11.00 m (36 ft 1 in); length (hull) 6.55 m (21 ft 6 in); width 3.37 m (11 ft 0⅔ in); height (including AA MG) 3.85 m (12 ft 7½ in)
Powerplant: one Rolls-Royce diesel developing 240 hp (179 kW) and Boeing gas turbine developing 300 shp (224 kW)
Performance: maximum road speed 28 km/h (17.4 mph); maximum range 230 km (143 miles); gradient 60%; vertical obstacle 0.95 m (3 ft 1½ in); trench 2.00 m (6 ft 6¾ in)

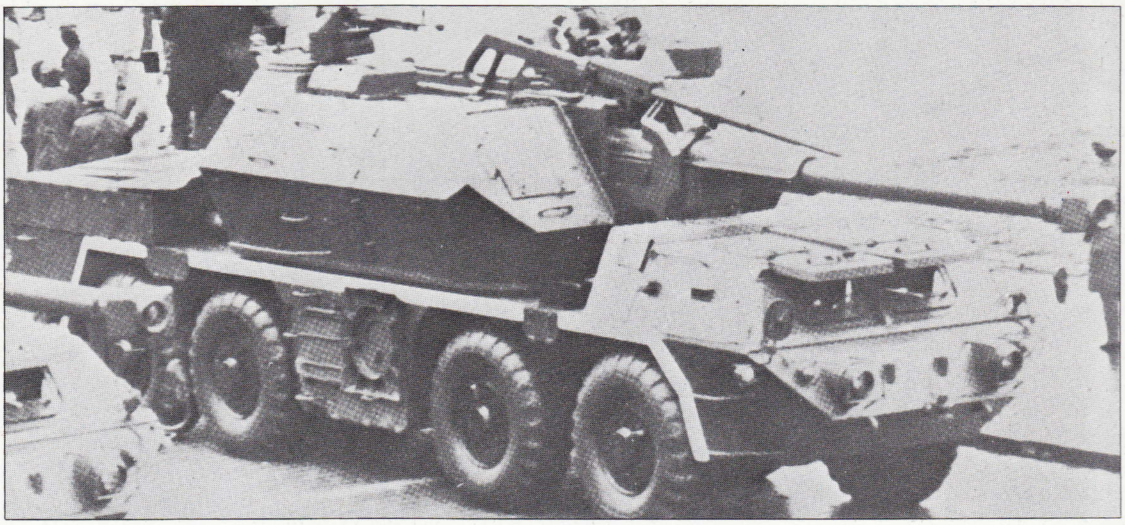
CZECHOSLOVAKIA

DANA 152-mm Self-Propelled Howitzer



Right: Only Czechoslovakia among the Warsaw Pact armies uses the DANA wheeled gun. The DANA is based on the 8×8 Tatra 815 high mobility truck chassis.

Below: The DANA is a cheaper but more roadworthy alternative to the tracked self-propelled guns now entering the Warsaw Pact inventories.



The Czech 152-mm (6-in) **DANA** is the first wheeled self-propelled howitzer to enter service in modern times, although full details and its exact role are still uncertain. Wheeled self-propelled artillery systems have a number of advantages over their more common tracked counterparts. Firstly, they are cheaper and easier to manufacture and to maintain and, secondly, they have a much greater strategic mobility as almost without exception wheeled armoured vehicles are much faster than their tracked counterparts and have a greater operational range. More recently South Africa has developed the 6×6 G6 155-mm (6.1-in) self-propelled howitzer, but this has yet to enter production or service.

It is almost certain that the DANA, which was first observed during a military parade held in 1980, is based on the 8×8 Tatra 815 truck, which probably has the best off-road performance of any truck in existence. The crew compartment is at the front, the fully enclosed turret in the centre and the armoured engine compartment at the rear. The armour is of all-welded steel and provides the crew with complete protection from small arms fire and shell splinters. It is believed that the crew normally travel in the front compartment, entering the turret only when coming into action.

The engine is coupled to a manual gearbox with 10 forward and two reverse gears, which in turn transmits power to a two-speed transfer box, so giving a total of 20 forward and four reverse gears. Steering is power-assisted on the front four wheels, and a central tyre-pressure regulation system allows the driver to adjust the tyre pressure to suit the type of ground being crossed.

Before firing commences three hydraulically-operated stabilizers (one at the rear of the hull under the engine compartment and one on each side between the second and third axles) are lowered to the ground for extra stability.

The turret has a limited traverse of between 30° and 40° left and right, and it is believed that the ordnance is based on that installed in the the Soviet M1973 self-propelled tracked howitzer, although the Czech weapon is longer and does not have a fume-extractor. The Czech Skoda works have a long history of successful artillery design and production, and it is quite possible that the ordnance has been designed and built there to fire Soviet ammunition. A hydraulic crane is fitted on the roof and it is believed that this is used to hoist ammunition into the turret, or perhaps forms part of an automatic or semi-automatic loading system. It is believed that the ordnance has a depression of −3° and an elevation of +60° for a maximum range of between 15000 and 20000 m (16,405 and 21,870 yards). The maximum rate of fire for a short period is four to five rounds per minute, reducing to one round per minute in the sustained-fire role. About 40 projectiles and charges are carried.

The DANA can ford to a depth of about 1.4 m (4 ft 7 in) but has no amphibious capability. Infra-red night-vision equipment is provided for the driver and commander. It is not thought to be fitted with an NBC system. So far the DANA has not been exported.

Specification (provisional)

Crew: 4 to 5
Weight: 23000 kg (50,705 lb)
Dimensions: length gun forward 10.5 m (34 ft 5 in); length hull 9 m (34 ft 6 in); width 2.8 m (9 ft 2 in); height 2.6 m (8 ft 6 in)
Powerplant: V-12 diesel developing 345 hp (257 kW)
Performance: maximum road speed 80 km/h (49.71 mph); maximum range 600 km (372.83 miles); gradient 60%; vertical obstacle 1.5 m (4 ft 11 in); trench 1.4 m (4 ft 7 in)

Anatomy of a Soviet Self-Propelled Artillery Unit

In recent years the USSR has shifted to the 'mobile firepower' and 'manoeuvre-by-fire' tactic and away from the World War II idea of massed artillery barrages. The direct consequences of this can be seen in the growing re-equipment with self-propelled artillery pieces by the Divisional Artillery Regiments.

The Soviet Union has three main types of division: motorized rifle, tank and airborne. Only the first two of these have self-propelled artillery units, the airborne division having towed 122-mm (4.8-in) D-30 howitzers and 85-mm (3.35-in) ASU-85 self-propelled anti-tank guns.

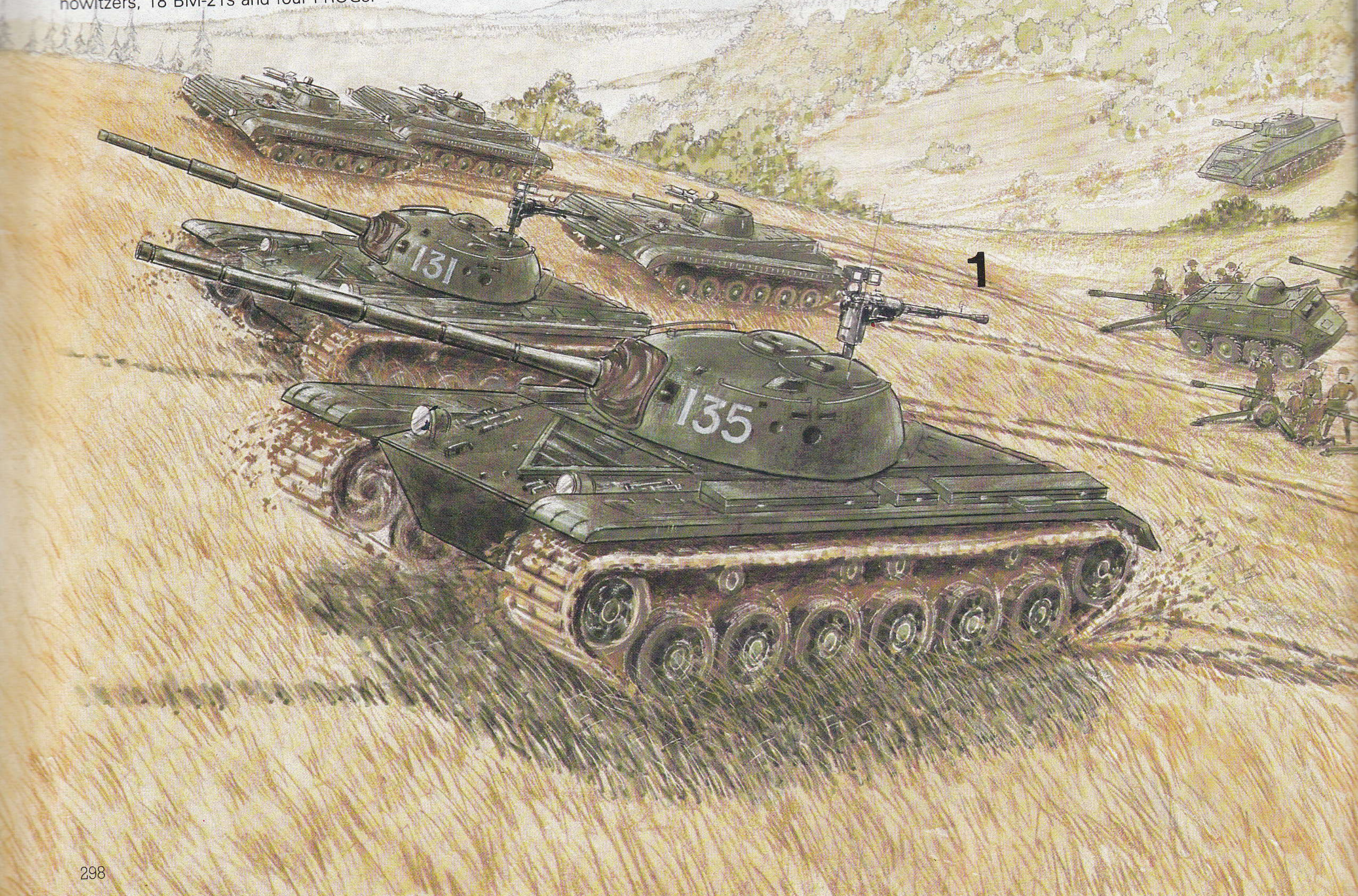
Each motorized rifle division has one artillery regiment with one battalion of 18 152-mm (6-in) M1973 self-propelled howitzers and two battalions of 122-mm (4.8-in) D-30 towed howitzers; the single tank regiment has one battalion of 18 122-mm (4.8-in) M1974 self-propelled howitzers; and the single motorized rifle regiment, equipped with BMP mechanized infantry combat also has a battalion of 122-mm (4.8-in) M1974s. The two motorized rifle regiments which are issued with BTR-60 or BTR-70 (8×8) armoured personnel carriers each have a battalion of 18 122-mm (4.8-in) D-30 towed howitzers. The reasoning behind this is that the towed howitzers can keep up with wheeled APCs whereas they cannot keep up with the faster-moving armoured vehicles across country. This gives the motorized rifle division a total of 18 M1973 self-propelled howitzers, 36 M1974 self-propelled howitzers and 72 D-30 towed howitzers. There is also a battalion of 18 122-mm (4.8-in) BM-21 multiple rocket systems and a FROG (Free Rocket Over Ground) battalion which has four launchers for the FROG-7 or the more recent and longer-ranged SS-21.

The artillery assets for the tank division consist of an artillery regiment identical to that of the motorized rifle division. Each of the three tank regiments has 18 122-mm (4.8-in) M1974 self-propelled howitzers, while the single BMP-equipped motorized rifle regiment has a battalion of 18 M1974s. The tank division also has the BM-21 and FROG battalions. This gives the tank division a total of 18 M1973 and 72 M1974 self-propelled howitzers, 36 D-30 towed howitzers, 18 BM-21s and four FROGs.

A 122-mm (4.8-in) M1974 self-propelled howitzer battalion has a total of 220 officers and men, a personnel strength considerably less than that of its British and American counterparts. The battalion consists of a battalion HQ (10 officers and men), an HQ platoon (20 all ranks), a supply and maintenance platoon (25 all ranks) and three self-propelled howitzer batteries each with six M1974s plus 55 officers and men. It has the usual trucks and light vehicles plus eight ACRVs (Armoured Command and Reconnaissance Vehicles, based on the M1974 chassis and issued on the scale of two per battery and two at HQ) and one BMP which is fitted with a target-locating radar, four rangefinders and a general-surveillance radar.

The artillery regiment has a headquarters and headquarters battery, three howitzer battalions (two with 122-mm/4.8-in and one with 152-mm/6-in weapons), motor transport, maintenance and medical companies, a target-acquisition battery and a supply and service platoon. The target-acquisition battery is the eyes and ears of the regiment, although information can come from other sources as well, such as aircraft, helicopters and RPVs. The target acquisition battery has a battery headquarters, communications, sound-ranging, reconnaissance and topographic platoons; and meteorological survey, radar and two surveillance radar sections. The battery has an impressive array of equipment to carry out its mission, including two armoured command vehicles based on the BTR-50, BTR-60 or older BTR-152 chassis, 18 trucks including one that contains the computer for the collation of all information obtained, two generators, two rangefinders, one sound-ranging set, one direction-finding radar, one meteorological radar, two mortar/artillery-locating radars (probably 'Big Fred', which is mounted on an MT-LB chassis), three surveillance radars and extensive communications equipment.

1 The powerful armoured element in any Soviet offensive requires that the accompanying infantry and artillery be able to keep up with the tank columns. While much of the Soviet infantry enters battle in wheeled vehicles, which can be supported by towed artillery, those equipped with the BMP infantry combat vehicle need self-propelled weapons to provide adequate support.



The 'Big Fred' radar is believed to have a similar function to the British Thorn-EMI Cymbeline radar used by the Royal Artillery and many other armies all over the world. The radar measures the slant range and bearing of two points in the mortar or artillery shell trajectory; the time taken for the shell to pass between the two points is also measured, and the computer uses this information together with the pre-set elevation angles to establish the exact position of the enemy mortar or artillery piece. This information is normally passed on to the command post, where it is decided which system (self-propelled gun or multiple-rocket launcher) is best positioned to deal with it.

The sound-ranging set is believed to be similar in function to the British Plessey sound-ranging link. This consists of a number of microphone positions connected by a radio data-link to a data-recording and processing centre. This system records the time differences of gun sounds reaching adjacent microphones. From this, bearing information is produced to provide the target location. This system is not of great use in a fast-moving battle because of the time needed to set it up and the amount of time it takes to establish the position of the target: if it is a self-propelled weapon it will probably have moved to a new position before the incoming artillery fire arrives.

The FROG battalion has a battalion HQ, HQ battery and two firing batteries. Each of the latter has a battery HQ, meteorological section, survey section (the launch site is surveyed well before the arrival of the missiles) and two Transporter-Erector-Launcher (TEL) sections, each with one FROG-7 or SS-21 with its chemical or tactical nuclear warhead.

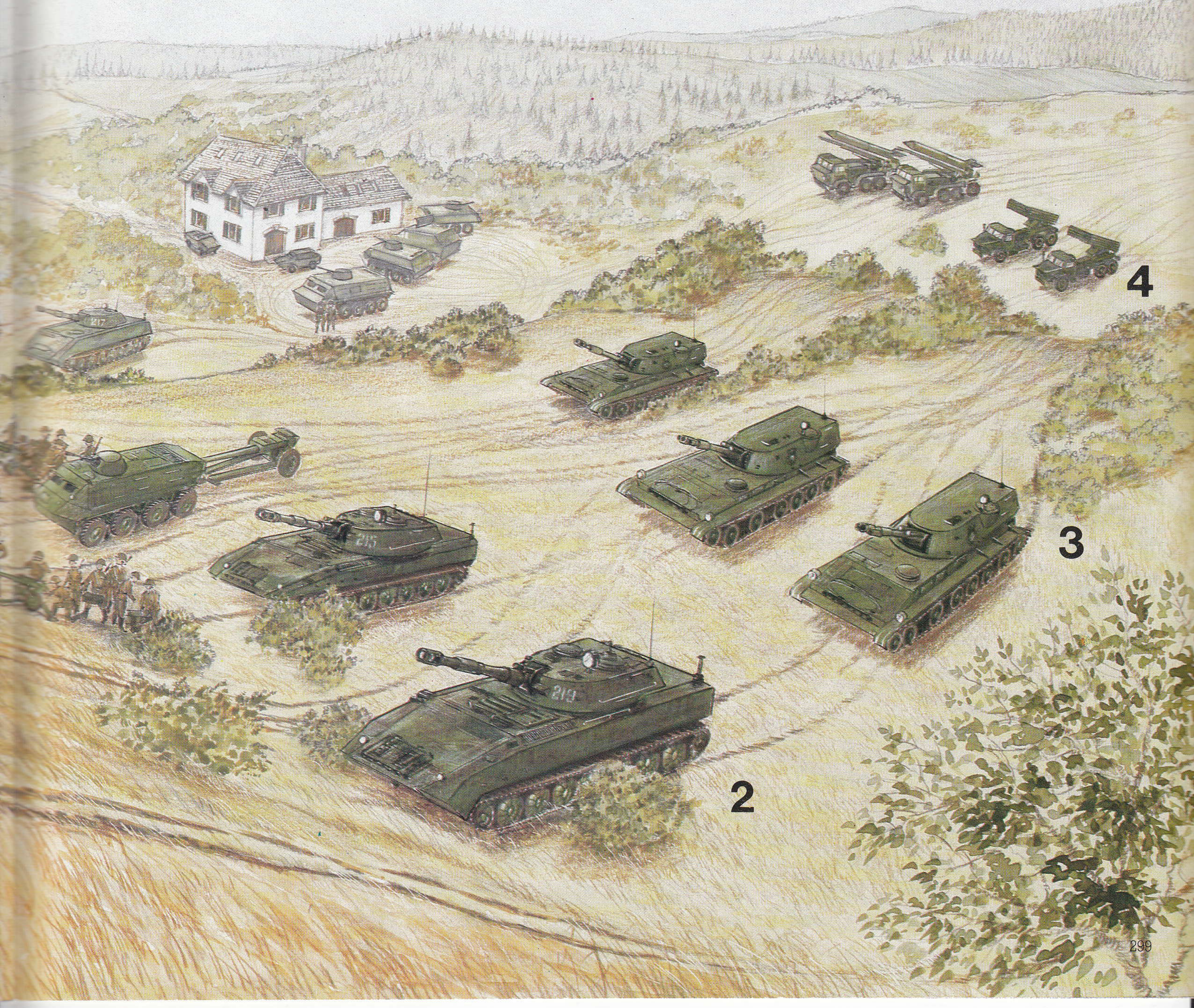
The artillery of the division can be used for both offensive and defensive operations. In the former role it will be used to engage enemy HQ and reserve positions, to deal with enemy artillery units that have already opened fire and, most important of all, to provide suppressive fire aginst forward units (including ATGW teams and infantry positions) and forward observers. This fire will be maintained until the Soviet tank and infantry units are only 250 or 300 m (275 or 330 yards) from their objective. Artillery fire will then lift and switch to the next line of defence or on possible reinforcement. The Soviets use their artillery well forward, and all self-propelled weapons (for example the M1973 and M1974) normally carry HEAT rounds to enable them to engage tanks in the direct-fire role should such be required, although normally these would be engaged by other units with tanks and ATGWs.

The Soviet Union also has some 14 artillery divisions, of which one is in East Germany. Each division has between three and six artillery regiments, one anti-tank battalion and one air-defence battalion, plus target-acquisition, motor transport, signals and other supporting units.

2 Soviet tactical doctrine places the artillery very close behind the advance, much closer than would be NATO practice. The 122-mm (4.8-in) M1974 howitzer would be present in largest numbers, providing suppressive fire against enemy observation posts and forward positions as little as 250 m (820 ft) ahead of the tank spearhead.

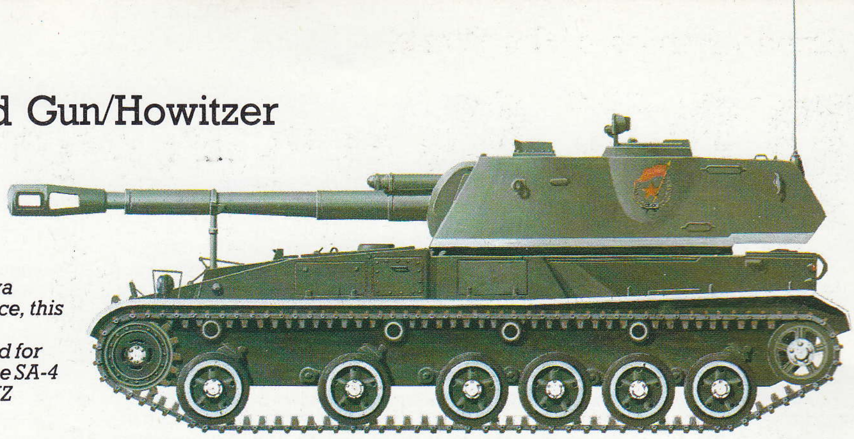
3 Heavy support is provided by the 152-mm (6-in) M1973 howitzer. With a range of up to 18500 m (60695 ft), the M1973 can engage enemy HQ and reserve positions, and can provide counter-battery fire, as directed by the spotting radar each battery has at its HQ. However, one result that comes from operating so close behind the assault is that the artillery must be prepared to meet enemy armour at any time. All Soviet howitzers carry and can fire HEAT rounds.

4 Behind the conventional artillery, the Soviets make great use of multiple rocket systems; these unguided missiles can provide massive suppressive power by saturating an area with high explosive. A logical extension of this philosophy would be the introduction of tactical nuclear weapons. Soviet mobile battlefield launch systems range from the 60-km (37-mile) range unguided FROG to the guided SS-12 and SS-22, which can fire warheads over hundreds of kilometres.



USSR

M1973 152-mm Self-Propelled Gun/Howitzer



Known as the SO-152 Akatsiya (Acacia) in Soviet army service, this vehicle forms the basis for a standard chassis design used for other purposes, including the SA-4 'Ganef' launcher and the GMZ minelayer.

The **M1973** 152-mm (6-in) self-propelled gun/howitzer is known as the **2S3** in the Soviet Union, and is issued on the scale of 18 per tank division and a similar number per motorized rifle division. The equipment is also known to be used by East Germany, Iraq and Libya. Its chassis is a shortened version of that used for the SA-4 'Ganef' surface-to-air missile system and GMZ armoured minelayer, which have both been in service with the Soviet Union for many years.

The M1973 has three compartments, that for the driver at the front, that for the engine to its right and that for the turret at the rear, the last being slightly forward of the very rear as it has such a large overhang. The torsion-bar suspension consists of six road wheels, with a distinct gap between the first and second and the third and fourth road wheels; the drive sprocket is at the front with the idler at the rear, and there are four track-return rollers.

The commander's cupola is on the roof of the turret, on the left side, and this is fitted with a 7.62-mm (0.3-in) machine-gun for local and anti-aircraft defence. This is the only hatch in the roof, but there is also a hatch in the right side of the turret. In the hull rear is a large hatch that opens downwards, and on each side of this is one circular hatch. These, and the two square openings in the turret rear, are believed to be used for the rapid loading of projectiles and fuses.

The ordnance is based on the 152-mm (6-in) D-20 gun/howitzer but with a bore evacuator, which helps stop fumes from entering the crew compartment when the breech is opened, to the rear of the double-baffle muzzle-brake. The ordnance fires an HE projectile weighing 43.5 kg (95.9 lb) to a maximum range of 18500 m (20,230 yards). Other projectiles that can be fired include HEAT (this will penetrate 300 mm/11.8 in of armour at 1000 m/1,095 yards), HE extended range (with a claimed range of 24000 m/26,245 yards), HE RAP (with a claimed range of 37000 m/40,465 yards), illuminating, smoke and 2-kiloton tactical nuclear. A total of 40 projectiles and charges is carried, and maximum rate of fire is four rounds per minute. The ordnance has an elevation of +60° and a depression of −4°; turret traverse is 360°.

Unlike the 122-mm (4.8-in) M1974 self-propelled howitzer, the M1973 does not have amphibious capability, although it can ford to a depth of 1.5 m (4 ft 11 in). The M1973 is fitted with an NBC system, and with night-vision equipment for the commander and driver.

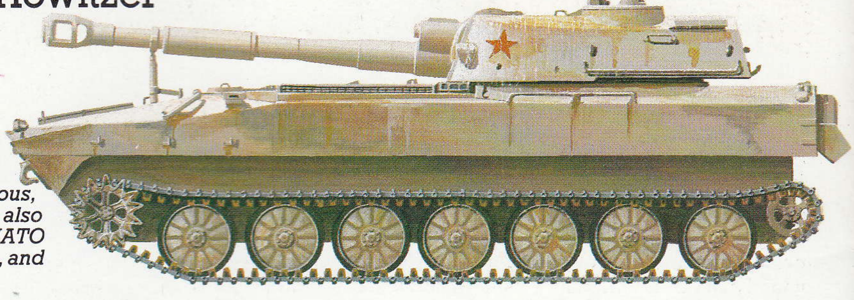
In recent years the Soviet Union has developed and placed in production at least three new weapons, a 152-mm (6-in) self-propelled gun, a 203-mm (8-in) self-propelled howitzer and a 240-mm (9.45-in) self-propelled mortar. It is believed that the last is probably an updated version of the 240-mm (9.45-in) M240 towed weapon which fires a chemical, high explosive fragmentation or nuclear projectile to a maximum range of 9700 m (10,610 yards). Photographs of the 152-mm (6-in) gun were released by the United States in 1982 and showed a chassis similar to that of the M1973 but with the ordnance in an unprotected mount on the top rear of the chassis. The ordnance is not fitted with a fume extractor, and when travelling is clamped in position. Located at the rear of the hull is a large spade.

Specification

Crew: 6
Weight: 25000 kg (55,115 lb)
Dimensions: length (gun forward) 8.40 m (27 ft 6⅔ in); length (hull) 7.80 m (25 ft 7 in); width 3.20 m (10 ft 6 in); height 2.80 m (9 ft 2¼ in)
Powerplant: one V-12 diesel developing 520 hp (388 kW)
Performance: maximum road speed 55 km/h (34 mph); maximum range 300 km (186 miles); gradient 60%; vertical obstacle 1.10 m (3 ft 7 in); trench 2.50 m (8 ft 2½ in)

USSR

M1974 122-mm Self-Propelled Howitzer



The M1974 has the Soviet designation SO-122 Gvozdika (Carnation) and is fully amphibious, unlike the SO-152. The chassis is also used for the TT-LB (or ACRV in NATO circles), a mine-clearing vehicle, and for a new chemical warfare reconnaissance vehicle.

In the period after World War II the Soviet Union placed its main emphasis on the continuing development of towed artillery whereas NATO emphasized self-propelled weapons. Although the latter are much more expensive to build, maintain and operate they do have many advantages over their towed counterparts, including increased cross-country mobility, full armour protection for the crew and ammunition, the possibility of an NBC system, and a reduction in the time necessary for the equipment to be brought into and taken out of action. The Soviet Union did continue to develop specialized tank destroyers such as the ASU-57 and ASU-85, but it was not until 1974 that the first 122-mm (4.8-in) self-propelled howitzer made its appearance during a parade in Poland, although it had doubtless already entered service with the Soviet Union by this date. NATO calls this 122-mm (4.8-in) self-propelled howitzer the **M1974**, this being the year when it was first seen, while the Soviet designation is **2S1**. The system is also used by Algeria, Angola, Czechoslovakia, Ethiopia, East Germany, Hungary, Iraq, Libya, Syria and Yugoslavia, and licensed production may well take place in Czechoslovakia and/or Poland. In the Soviet army the M1974 is employed on the scale of 36 per motorized rifle division and 72 per tank division.

The layout of the M1974 is similar to that of the American M109 with the engine, transmission and driver at the front and the fully enclosed turret at the rear. The suspension is adjustable, and consists of seven road wheels with the drive sprocket at the front and the idler at the rear; there are no track-return rollers. For normal use 400-mm (15.75-in) wide tracks are fitted, but when operating in the snow or swampy areas 670-mm (26.4-in) wide tracks are fitted to reduce the vehicle's ground pressure as much as possible. Standard equipment includes an NBC system and a full suite of night-vision equipment for the driver and commander. The M1974 is fully amphibious, being propelled in the water by its tracks at a speed of 4.5 km/h (2.8 mph).

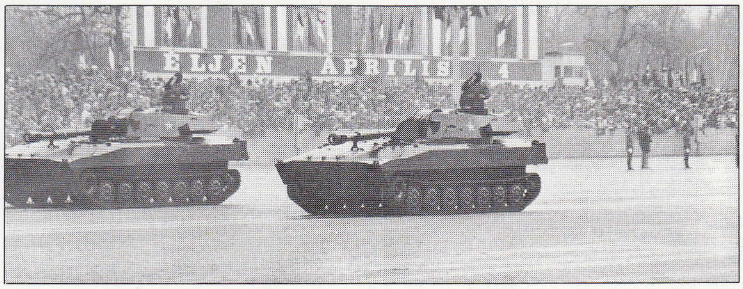
The turret is fitted with a modified version of the standard 122-mm (4.8-in) D-30 towed howitzer, which has an elevation of +70° and depression of −3°; turret traverse is 360°. Turret traverse and weapon elevation are electric, with manual control for emergency use. The ordnance has a double-baffle muzzle-brake, a fume-extractor and a semi-automatic vertical sliding breech block; an ordnance travel lock is mounted on top of the hull. The howitzer fires an HE projectile weighing 21.72 kg (47.9 lb) to a maximum range of 15300 m (16,730 yards), and can also fire chemical, illuminating, smoke and HEAT-FS projectiles. The last is used to engage tanks and will penetrate 460 mm (18.1 in) of armour at an incidence of 0° at a range of 1000 m (1,095 yards). It is also reported that an HE RAP is available, and that this has a maximum range of 21900 m (23,950 yards). A normal ammunition load consists of 40 projectiles: 32 HE, six smoke and two HEAT-FS. It is believed that a power rammer is fitted to permit a higher rate of fire (five rounds per minute) and also to enable the ordnance to be loaded at any angle of elevation.

The chassis of the M1974 is also used for a number of armoured command and reconnaissance vehicles (ACRVs) fitted with the 'Big Fred' artillery/mortar-locating radar, and for a specialized mine-clearing vehicles. The latter is similar in concept to the British Giant Viper.

Specification

Crew: 4
Weight: 16000 kg (35,275 lb)
Dimensions: length 7.30 m (23 ft 11½ in); width 2.85 m (9 ft 4 in); height 2.40 m (7 ft 10½ in)
Powerplant: one YaMZ-238V V-8 water-cooled diesel developing 240 hp (179 kW)
Performance: maximum road speed 60 km/h (37 mph); maximum range 500 km (310 miles); gradient 60%; vertical obstacle 1.10 m (3 ft 7 in); trench 3.00 m (9 ft 10 in)

Two of the 25 SO-122 guns currently credited with being in service with the Hungarian army.



RAF Support Command

Below left: RAF Support Command supplies basic flying training for the Royal Navy at Topcliffe. The aircraft used is the Bulldog T.Mk 1, which has proved well-liked, and is also flown by the CFS and the University Air Squadrons.

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No fighting formation can operate for long without a back-up force to maintain its equipment and train personnel for the front line, and within the Royal Air Force, Strike Command and RAF Germany look to Support Command to maintain their acknowledged efficiency. From headquarters at Brampton, near Huntingdon, Support Command combines the remaining duties of the former Flying Training, Technical Training, Maintenance and Reserve Commands, performing a wide variety of functions that range from the repair and modification of a £13 million Panavia Tornado to providing a 14-year-old air cadet with a five-minute familiarization flight in a glider.

Support Command is the first stop for all personnel entering RAF service, and those planning a flying career may make this contact even before donning uniform. The training of pilots and aircrew is one of the command's foremost functions, the process beginning in many cases with the applicant being sponsored for a university course. Here, he becomes a member of one of the 16 University Air Squadrons and flies some 70 hours on BAe Bulldog T.Mk 1s during a three-year period.

Graduate studies at an end, the prospective pilot transfers to the world-renowned RAF College at Cranwell to make his acquaintance with the standard RAF basic jet trainer, the BAe (BAC) Jet Provost. At Cranwell, 77 hours are flown in 31 weeks on the T.Mk 5A version of the aircraft, at which point the student joins compatriots from the alternative 'direct entry' stream.

About half the RAF's pilots come from direct entry, in which case the first step is a 15-hour grading course on the venerable de Havilland Chipmunk at the Flying Selection Squadron to weed out those who obviously lack the aptitude for flying duties. Once past this hurdle, the new entrant undertakes the basic stage on the unpressurized Jet Provost T.Mk 3A at either No. 1 or No. 7 Flying Training School, in the form of 97 hours' flying in 37 weeks.

Specialist training

By this time, aspirants and their instructors will know which branch of flying is best suited to their talents, and so 'streaming' is introduced. Those chosen for front-line fast jets remain with their units for 58 hours in 15 weeks on the Jet Provost T.Mk 5A and then go to No. 4 FTS to fly BAe Hawk T.Mk 1s in the advanced course of 85 hours.

After this, Strike Command takes over for courses of tactical weapons training and operational conversion. By the time the freshly-qualified pilot reports to his first squadron, his training represents an investment of £2 million by the taxpayer.

Future transport pilots have another 27 hours (eight weeks) on Jet Provost T.Mk 5As, a prelude to attending the Multi-Engine Training Squadron within No. 6 FTS, there to fly 45 hours on the BAe Jetstream in eight weeks. Helicopter personnel go straight from streaming to No. 2 FTS for 75 hours on the Aérospatiale Gazelle and 50 hours on the Westland Wessex in 28 weeks.

Maintenance of high standards of training is of critical importance to the front line, and these are best achieved by ensuring that instructors are competent to teach: there is little value in having the world's best pilot on the staff of an FTS if he is incapable of communicating his skills to others or differentiating between a slow learner and a 'no-hoper'.

The Central Flying School is the oldest military flying training establishment in the world, and is responsible for providing Support Command instructors, the unit lodging at several bases to share aircraft with FTSs for economy reasons. Headquarters of the CFS are at Leeming, but a move is in prospect to Scampton, where it is expected that some of the diverse elements of the school will again be collected at a single base. First of the CFS elements to move in, during 1983, were the Red Arrows, the UK's most famous aerobatic team.

Support Command's most famous aircraft are the 'Red Arrows' aerobatic team.

Four Jet Provost T.Mk 5As against the sunset. These aircraft belong to the 'Poachers' aerobatic team from the RAF College at Cranwell.

Aircrew instruction

Support Command additionally trains aircrew at Finningley, where navigators, air electronics officers and air engineers fly 85, 48 and 25 hours respectively in BAe (HS) Dominie T.Mk 1s, the first-mentioned also receiving 30 hours of low-level experience in Jet Provost T.Mk 5As.

Consideration currently is being given to Jet Provost replacement, a wide variety of options presenting themselves. The RAF was the first air force to adopt *ab initio* jet training with the side-by-side two-seat Jet Provost and first thoughts on a follow-on type embraced this concept. Now, tandem seating has found favour as a logical lead-in to the Hawk, even though the more intimate environment of the Jet Provost is considered by some to be better suited to pupil-instructor communication during the important early stages of learning.

BAe has accordingly changed the seating in its P.164 project (a turbofan-powered aircraft more economical to operate than the Jet Provost), although further cost-saving may be achieved by adoption of a turboprop for the basic stage, NDN Aircraft making a strong bid with the Turbo Firecracker in the face of intense foreign competition.

Turboprop purchase is complicated by the fact that such an aircraft would be unsuitable for Jet Provost replacement in the first part of the advanced course and for the Refresher Fying Squadron. Based at Leeming, but soon to move to Linton-on-Ouse, the RFS re-orientates officers returning to flying after a desk appointment or transferring from large to small aircraft.

Support Command's flying responsibilities further include the Air Cadets' organizations (Air Training Corps and RAF section of the Combined Cadet Force) which have 13 Air Experience Flights (most with Chipmunks) and 27 Volunteer Gliding Schools flying Slingsby Venture T.Mk 2 powered sailplanes, Slingsby Sedbergh TX.Mk 1s and Slingsby Cadet TX.Mk 3s, the two last-mentioned being replaced from 1983 onwards by ASK 21 Vanguards.

The Air Cadet organization is mainly staffed by officers of the RAF Volunteer Reserve (Training) who come under Support Command for their part-time duties. In recent years, Air Cadets have been providing some 25 per cent of the annual RAF intake and 40 per cent of aircrew, so the effort expended in their direction represents sound reasoning.

Support and supply

On the ground, Support Command maintains both schools and supply organizations. Officers destined for a variety of ground postings receive instruction at Cranwell or at the RAF Technical College, Henlow, and airmen gain skills at the two Schools of Technical Training: No. 1 at Halton and No. 2 at Cosford. In addition, speedy repair of aircraft battle damage is now receiving high priority with the recent addition of a training school at Scampton. Methods of maintaining existing and prospective aircraft with the maximum of efficiency are researched at the Central Servicing Development establishment at Swanton Morley.

Air Traffic control staff receive their training at the Central Air Traffic Control School, Shawbury. Whilst this can be accomplished largely in the classroom, the school has a fleet of Jet Provost T.Mk 4s at its disposal for students to control for added realism during the latter stages of their course.

The major operations necessary to keep aircraft in full operational conditions are mainly the domain of Support Command, operating units normally only undertaking routine tasks. Overhauls, conversions, principal modifications and resprays, together with storage, are undertaken at what were formerly named Maintenance Units, but now have individual titles.

St Athan is the home of the RAF Engineering Wing with wide-ranging responsibilities for almost all types, although SEPECAT Jaguars, Hawker Hunters and Hawks are handled by Nos 1 and 2 Aircraft Maintenance Squadrons at Abingdon, where there is also a battle damage repair flight and an Aircraft Salvage and Repair Flight. Storage is mainly at Shawbury since No. 5 MU at Kemble closed in 1983 and became a USAF support depot.

On a smaller scale, other Maintenance Units hold and distribute an unimaginably wide variety of items, from bombs to furniture, and include No. 11 MU at Chilmark (ordnance), No. 30 at Sealand (avionics) and No. 213 at Cardington (oxygen), plus general supply units No. 7 MU, Quedgeley; No. 14, Carlisle; No. 16, Stafford; and No. 25, Hartlebury.

From the foregoing, it will be seen that Support Command comprises all the parts of the RAF not immediately concerned with fighting the enemy. However, the temptation must be resisted to regard it as a mere hodge-podge of left-overs, for without its vital services, the 'sharp end' of the RAF would rapidly become blunted.

RAF SUPPORT COMMAND FLYING UNITS

Flying Training Schools

Unit	*Base*	*Aircraft*	*Role*
No. 1 FTS	Linton-on-Ouse	Jet Provost T.Mk 3A/T.Mk. 5A	basic training
No. 2 FTS	Shawbury	Gazelle HT.Mk 3 Wessex HC.Mk 2	helicopter training
No. 3 FTS	Leeming	Jet Provost T.Mk 3A/T.Mk 5A	Refresher Flying Squadron
	Topcliffe	Bulldog T.Mk 1	Royal Navy Elementary FTS
No. 4 FTS	Valley	Hawk T.Mk 1	advanced training
No. 6 FTS	Finningley	Jetstream T.Mk 1	Multi-Engine Training Squadron
		Dominie T.Mk 1	aircrew training
		Jet Provost T.Mk 5A	navigator training
No. 7 FTS	Church Fenton	Jet Provost T.Mk 3A/T.Mk 5A	basic training
RAFC	Cranwell	Jet Provost T.Mk 5A	basic training
CFS	Leeming	Jet Provost T.Mk 3A/T.Mk 5A	instructor training
		Bulldog T.Mk 1	
	Shawbury	Gazelle HT.Mk 1	
	Valley	Hawk T.Mk 1	
	Scampton	Hawk T.Mk 1	The Red Arrows
FSS	Swinderby	Chipmunk T.Mk 10	student assessment